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Volume 16, Number 15
Abstracts 18713–20040

August 15, 1962

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Volume 16, Number 15 August 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

18713 (AFSWC-TN-61-26) NUCLEAR WEAPONS EFFECTS ON HARDENED STRUCTURES. A Summary of Recent Reports Produced under AFSC Project 1080. John E. Scott, comp. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Sept. 1961. 79p. (AD-266254)

Abstracts or summaries are presented for 76 publications. (C.H.)

18714 (BMI-1569(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1962. Contract W-7405-Eng-92. 85p.

Research and development progress is reported on reactor materials and components, fuels, fuel elements, growth of UO_2 single crystals, materials evaluation, coated-particle fuel materials, radioisotope and radiation uses, corrosion studies of the fluoride-volatility process, cold-bonding processes, long-term creep-rupture program on sintered aluminum powder alloys, radiation effects on candidate fuel materials for the MGCR, materials studies for SM reactors, and gas-cooled reactors. (M.C.G.)

18715 (PNE-126P) PRELIMINARY REPORT OF WEATHER AND SURFACE RADIATION PREDICTION ACTIVITIES FOR PROJECT GNOME. (Weather Bureau, Las Vegas, Nev.). [1962]. 20p. Project GNOME.

Development of predictions of the state of the atmosphere as it might have affected test operations is discussed. The weather observational program and analysis procedures are described. Trajectories up to 24 hr at various levels up to 9000 ft were constructed, consistent with wind, topographic, and stability conditions over the area. Radiation predictions issued for GNOME and comparisons with observed radiation levels are given. (M.C.G.)

18716 (PNE-130P) HYDROLOGIC AND GEOLOGIC STUDIES FOR PROJECT GNOME. Preliminary Report. (Geological Survey, Washington, D. C.). Feb. 1962. 50p. Project GNOME.

Geologic information required to define the pre- and post-shot physical and chemical characteristics of the salt and other rocks affected by the explosion was gathered. Information on the pre- and post-shot hydrologic conditions at the site and the surrounding area was also obtained. (M.C.G.)

18717 (PNE-131F) FEDERAL AVIATION AGENCY AIRSPACE CLOSURE; PROJECT GNOME, PRELIMINARY AND FINAL REPORT. H. H. Mark (Federal Aviation Agency. Air Route Traffic Control Center, Albuquerque, N. Mex.). Dec. 6, 1961. 15p.

Work carried out to ensure airspace user safety during Project GNOME by restricting designated airspace is described. (M.C.G.)

18718 (PNE-132F) OFF-SITE RADIOLOGICAL SAFETY REPORT, CARLSBAD, NEW MEXICO. O. R. Placak (Public Health Service, Las Vegas, Nev.). 1961. 97p. Project GNOME. 106p.

A summary is presented of the off-site radiological safety activities of the U. S. Public Health Service during the Project Gnome operation. Topics discussed include: operational procedures; collection of data by aerial monitoring, mobile monitoring, potash mine surveys, air sampling, milk sampling, water sampling, soil and vegetation sampling, and a film badge program; laboratory control, emergency measures; medical services; and veterinary activities. It was concluded that no persons in the vicinity of the Gnome test site received harmful amounts of radiation either internally or externally. (M.C.G.)

18719 (RDA-1) RESEARCH AND DEVELOPMENT ABSTRACTS OF THE USAEC, JANUARY–MARCH 1962. (Division of Technical Information, AEC). 48p.

Abstracts of AEC research and development reports falling outside the scope of NSA are presented. The abstracts are arranged in the following categories: general and miscellaneous; biology and medicine; chemistry; engineering and equipment; instrumentation; geology, mineralogy, and meterology; mathematics and computers; metals, ceramics, and other materials; and physics. Corporate author, personal author, subject, and report number indexes are included. (M.C.G.)

18720 (WT-1451) RESPONSE OF PROTECTIVE VAULTS TO BLAST LOADING. E. Cohen, E. Laing, and A. Bottenhofer (Ammann and Whitney, New York). Apr. 1961. Project 30.4 of Operation PLUMBBOB. 87p.

A reinforced-concrete steel-plate-lined vault and steel vault door were exposed to a nuclear detonation (shot Priscilla, about 37 kt, balloon suspended, at 700 ft) at the predicted 75-psi peak incident pressure level (1150 ft from Ground Zero). The vault was designed by the ultimate-strength theory to utilize the additional strain energy available in the elastoplastic and plastic ranges. Flexural and thrust capacities were determined, and shear capacity was computed. It was established that above-ground structures can be designed and constructed to survive the pressure levels experienced by this structure. The vault and door provided adequate blast and thermal protection for normal usage, and the structure was adequate to resist overturning and excessive sliding under conditions of the test. (auth)

18721 (WT-1455) EVALUATION OF NUCLEAR BLAST EFFECTS ON AEC TEST-SITE FACILITIES (PARTS I, II, AND III). R. A. Cameron, Jr., R. A. Williamson, and R. H. F. Boothe (Holmes and Narver, Inc., Los Angeles). June 1959. Project 34.3a [of] Operation PLUMBBOB. Contract [AT(29-2)-20]. 163p.

A summary of before- and after-blast observations concerning test structures is presented. The studies were conducted to obtain information of value in designing blast-resistant structures. Information is included on measurements of retaining-wall displacements, measurements of tower displacements, and measurements on miscellaneous structures. (J.R.D.)

18722 (AEC-tr-4148) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Nukleonika, 3: No. 5, 487-573; 575-88; 599-605(1958). 86p.

Ten selected articles from Nukleonika, Vol. 3, No. 5, were translated from Polish. Topics covered include: Polish nuclear energy program, electromagnetic isotope separators and their application to nuclear physics, application of labeled compounds in quantitative staining reactions in biology, determination of C^{14} in Geiger-Mueller counter filled with a mixture of CO_2 or CO and a heavy saturated hydrocarbon, prospecting for uranium ores in Poland, problems of plutonium fuel cycles, application of radioisotopes for research and economic purposes in the USSR, radioisotope applications in medicine and biology, nuclear spectroscopy, and neutron counters with BF_3. (M.C.G.)

18723 (AEC-tr-4149) SELECTED ARTICLES FROM NUKLEONIKA. Translation of Nukleonika, 3: No. 6: 615-31; 633-78; 695-708(1958). 67p.

Eight selected articles from Nukleonika, Vol. 3: No. 6 were translated from Polish. Topics covered include: temperature calculations in heterogeneous thermal neutron reactors, scalers based on Eccles-Jordan type trigger circuits, uranium geochemistry and the possibilities of its natural concentration, fluidization in the isotopic exchange contact reaction HD + H_2O vapor $\rightleftharpoons$ H_2 + HDO vapor, filters for aerosols on radioactive substances, second Polish-Czechoslovak conference on nuclear energy, and scintillation counters. (M.C.G.)

18724 (AEC-tr-4152) NUKLEONIKA. Translation of Nukleonika, 4: No. 3, 241-51; 253-83; 285-303; 305-27; 330-43(1959). 87p.

Eight selected articles from Nukleonika, Vol. 4: No. 3 were translated from Polish. Topics covered include: scattering and thermalization of neutrons by bound nuclei, reactor period as a function of the multiplication factor in the subcritical state, a method of assessing domestic uranium ores, absolute methods of measurement of activity of beta and gamma emitters, halogen-quenched G-M counters, nuclear propulsion in merchant vessels, and summaries of papers presented at a symposium of the radiochemical division of Nuclear Research Institute. (M.C.G.)

18725 (AEC-tr-5056) EFFECT OF UNDERWATER SHOCK WAVES CAUSED BY DETONATION ABOVE THE WATER SURFACE. Gunnar Lindh. Translated from Tidskr. Kustartilleriet, No. 1, (1961). 26p.

Also issued originally as Kungl. Fortifikationsförvaltningen Befästningsbyrån report No. B-25, Mar. 1961.

A method for theoretically determining the effect in water of shock waves from charges detonated above the water's surface is described. Several examples show that nuclear charges heavier than several tens of kilotons maximum pressures are obtained which must be taken into account in calculations of the effect on submarines, mines, etc. (auth)

18726 (UCRL-Trans-820(L)) ON THE STUDY OF SEISMIC EFFECT OF POWERFUL EXPLOSIONS. L. A. Utkin. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Trudy Gorno-Geol. Inst., Akad. Nauk S.S.S.R., Ural. Filial, No. 54, 125-30(1960). 11p.

Methods of studying large-scale explosions are discussed. Included are discussions on visual observation, study of ground and structure oscillations, transometric studies, piezoelectric studies, and ultrasonic studies. (J.R.D.)

18727 A FORUM REPORT. ATOMFORUM, 1961. PROGRESS, PROBLEMS, POLICY. Proceedings of the Annual Conference, November 6, 7, 8, 1961, Chicago, Illinois. William J. Smith, ed. (Atomic Industrial Forum, Inc., New York). 1962. 102p. $7.50.

Twenty-three papers are presented on nuclear propulsion in space exploration, nuclear power sources for space applications, reactor safety, nuclear power, industrial uses of radiation and radioisotopes, and national policy and nuclear progress. Discussions are presented on nuclear space program, government-industry research team, and civilian reactor program. (N.W.R.)

18728 ADVANCES IN HYPERVELOCITY TECHNIQUES. Arthur M. Krill, ed. Proceedings of the Second Symposium on Hypervelocity Techniques, University of Denver, Denver Research Institute, 20 and 21 March 1962. New York, Plenum Press, 1962. 803p. $19.50.

Twenty-eight papers are included on developments in the production of hypervelocity environments and on associated instrumentation. Topics of particular interest include: the use of an electrodeless plasma accelerator as a hypersonic wind tunnel and transient plasma diagnostics for wake studies. Other papers deal with the design, operation, theory, performance, and use of wind tunnels and associated equipment; and hypervelocity theory of shock tubes and space. (N.W.R.)

18729 PROJECT PLOWSHARE. THE DEVELOPMENT OF THE PEACEFUL USES OF NUCLEAR EXPLOSIONS. Ralph Sanders. Washington, D. C., Public Affairs Press, 1962. 214p. $4.50.

Project Plowshare is analyzed in order to show the need for nuclear explosives for peaceful purposes. Information is given on ways to harness nuclear explosives to man's wishes and the potential of the explosives in building civilization. Past experiments are explained and future experiments needed are suggested. Information is also given on foreign policy guidelines in regard to solving economic and social problems through Project Plowshare. (N.W.R.)

18730 ECONOMISCHE ASPECTEN VAN DE ONTWIKKELING DER KERNENERGIE. (Economic Aspects of the Development of Nuclear Energy). A. A. De Boer. Thesis, Utrecht, Universiteit, 1962. 113p.

An examination is made of the ways and means of ensuring that the production of nuclear energy is achieved in the most advantageous possible way. On the one hand, nuclear power must take over an optimum proportion of the total energy supplies; on the other hand, uranium must play a favorable part in the primary materials' supply market. Apart from this, however, the interest of general prosperity dictates that industry must participate as much as possible in technological progress; further, a nuclear energy sector can serve to promote its export. Furthermore, the

development of new methods and materials in this sector has its repercussions on the over-all standards of the enterprise concerned. As a conclusion, it is stated that, from an economic as well as from a political and social standpoint, in the public interest nuclear energy development has to be stimulated to a very large extent. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

Refer also to abstracts 18802 and 18804.

18731 (DASA-1245) TERTIARY BLAST EFFECTS: THE EFFECTS OF IMPACT ON MICE, RATS, GUINEA PIGS AND RABBITS. Technical Progress Report. D. R. Richmond, I. G. Bowen, and Clayton S. White (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Feb. 28, 1961. Contract DA-49-146-XZ-055. 63p.

A total of 455 mice, rats, guinea pigs, and rabbits was subjected to impact at velocities ranging between 25 ft/sec and 51 ft/sec. The desired velocities were generated by allowing the animals to free-fall from various heights to a flat concrete pad. The ventral surface of each animal was the area of impact. Probit analyses of the 24-hr mortality data yielded LD_{50} impact velocities with 95% confidence limits as follows: mouse, 39.4 (37.4 to 42.0) ft/sec; rat, 43.5 (42.0 to 44.8) ft/sec; guinea pig, 31.0 (30.0 to 31.9) ft/sec; and rabbit, 31.7 (30.2 to 33.3) ft/sec. The LD_{50} figures for the mouse and rat were significantly higher, statistically, than those for the guinea pig and rabbit. The small spread in the LD_{50} values suggested little variation in the tolerance of biological systems to impact. Further, the steepness of the mortality curves indicated a narrow survival range to impact. Extrapolation of the experimental data to the 70 kg animal yielded a predicted LD_{50} impact velocity of 26 ft/sec (18 mph). Literature relevant to the human case was reviewed and the tentative applicability of the predicted figures to adult man is discussed. (auth)

18732 (DASA-1246) A SHOCK TUBE UTILIZED TO PRODUCE SHARPRISING OVERPRESSURES OF 400 MILLISECONDS DURATION AND ITS EMPLOYMENT IN BIOMEDICAL EXPERIMENTATION. Technical Progress Report. D. R. Richmond, V. R. Clare, V. C. Goldizen, D. E. Pratt, R. T. Sanchez, and C. S. White (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Apr. 7, 1961. Contract DA-49-146-XZ-055. 46p.

A shock tube employed for blast biology studies is described along with the results of one series of experiments. The shock tube is air-driven and utilizes Mylar plastic diaphragms. The compression chamber is 17.5 ft in length and 40.5 in. ID; it reduces in diameter to 23.5 in. over a 3-ft-long transition section just upstream of the diaphragm station. The expansion chamber consists of 30 ft of 23.5 in. ID tubing followed by 22 ft of 40.5 in. ID tubing. It is closed distally by a steel end-plate to generate high pressures from the reflected shock. Three vents in the expansion side of the system serve to control the duration of the overpressure and to eliminate multiple reflections by bleeding off the reflected shock as it travels upstream. An interspecies correlation is presented based on mortality data from six species of experimental animals with an extrapolation to a 70 kg animal. (auth)

18733 (NP-11678) RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE. Annual Progress Report to National Aeronautics and Space Administration. (Resources Research, Inc., Washington, D. C.). Feb. 15, 1962. Contract NASr-10. 92p.

The feasibility of a radioisotopic biochemical experiment for extraterrestrial life detection has been established. A medium has been developed which supports the evolution of detectable levels of radioactive carbon dioxide by representative bacteria, streptomycetes, fungi, and algae within a period ranging from minutes to several hours. The group of test organisms which respond includes aerobes, anaerobes, facultative anaerobes, thermophiles, mesophiles, heterotrophs, phototrophs, spore formers, and non-spore formers. Mixed populations in soils have been tested with excellent response. A number of radioactive substrates have been tested singly and in combinations. The most satisfactory response has been achieved through the combined use of sodium formate-C^{14} and uniformly labeled glucose-C^{14}. Two generations of the instrumentation for the experiment have been fabricated and modifications made to the second model. At the present time the instrument, programmer, and associated electronics weigh approximately one and one-quarter pounds. The soil sample is obtained by ejection of two fifty foot lengths of adhesive impregnated string. The string, with collected soil particles, is reeled back into the culture chamber. Here the radioactive medium is applied, and a solid state radiation detector monitors metabolically evolved labeled gases. The instrument has been successfuly field tested. (auth)

18734 (TID-15690) A METHOD OF QUANTITATIVELY MEASURING LOW LEVEL AMOUNTS OF RADIUM IN HUMAN BONE (thesis). Robert R. Landolt (Kansas. Univ., Lawrence). May 1961. 48p.

A method was devised for measuring low level amounts of radium by photographic film dosimetry. This procedure involved construction of simulated bone standards which were used by comparison to measure any amount of radium in human bone, provided the radium is distributed uniformly within the bone. These standards contained concentrations of radium ranging from 0.00342 microcurie per gram to 0.239 microcurie per gram, which provide a wide range of alpha-particle activities. The simulated bone standards were constructed by making bone paste using human bone powder, radium chloride solution and a small amount of gelatin. The paste was allowed to harden in polyethylene molds. The standards were then mounted in a Plexi-glass container into which autoradiographic plates were placed for exposure. Several tests were performed upon the bone standards and a measurement of the beta-particle absorption from a Y^{-90} source was made. The absorption curve obtained was very close to the absorption curve obtained from a similar test performed on natural bone. Another test performed on the standards was the measurement of the relationship between the number of tracks produced by the various concentrations of radium. Information from the tests was used to derive a formula which may be used to calculate the concentration of an unknown amount of radium. This formula included a correction factor for the difference in radon escape from the bone standard and from the bone under investigation. A method was described for measuring the percent radon escape from the standards which may also be used to measure the percent radon escape from the sample bone. (auth)

18735 REGIONAL BLOOD FLOW OF THE CEREBRAL CORTEX DETERMINED BY KRYPTON. David H. Ingvar and Niels A. Lassen (Univ. of Lund, Sweden). Acta Physiol. Scand., 54: 325-38(Mar.-Apr. 1962). (In English)

A new method for determining regional blood flow in tis-

sue by means of the inert radioactive gas Krypton^{85} is presented. The method has been applied on the exposed cerebral cortex of anesthetized rabbits, cats, and dogs. The radioisotope Kr^{85}, a weak beta emitter, was dissolved in saline which was then injected into the carotid artery of the hemisphere to be studied. The rapid uptake and slower clearance of the isotope was recorded from a small area of the exposed cortical surface, about 1 mm in depth. The theory of analyzing the clearance curves and of calculating the average regional cortical blood flow in ml per gram per minute is described. The method requires constant blood flow in the tissue during the measurement (about 5 min). It may, however, to some extent be used for studies of acute changes in perfusion. It is also possible to use it in a continuous fashion. It has been possible to confirm and to study in quantitative terms the correlation between arterial carbon dioxide tension or cortical functional activity, and the regional cortical blood flow. The method is simple to use and permits repeated measurements in the same experiment with minimal interference with the functional activity of the brain. The method may readily be adapted for studies in man. (auth)

18736 STUDIES ON THE MECHANISM OF CELLULAR SENSITIZATION TO ULTRAVIOLET RADIATION BY HALOGENATED PYRIMIDINES. [PART] I. William H. Prusoff (Yale Univ., New Haven). Biochim. et Biophys. Acta, 58: 588-90(Apr. 23, 1962). (In English)

Studies on the effect of ultraviolet radiation on various halogenated and nonhalogenated derivatives of pyrimidines showed that the mechanism whereby halogenated pyrimidines sensitize cells to ultraviolet radiation is not related solely to photochemical events such as dimer formation or hydration of the 5,6-double bond. The influence of pH on the response of 2'-deoxyuridine and thymidine in the frozen state to ultraviolet radiation was striking. Data are tabulated. (C.H.)

18737 CUTANEOUS RADIOVACCINATION OF THE RAT. Jean Loiseleur, Liliane Catinot, and Annick de Vomecourt. Compt. rend., 254: 1881-3(Mar. 5, 1962). (In French)

A treatment combining an injection of dinitrophenol, methylene blue, and aminothiazol with a primary cutaneous irradiation causes a persistent radioresistance of the cutaneous tissue, which is then found to be radiovaccinated. (tr-auth)

18738 LONG-TERM RETENTION OF RADIOCESIUM BY MAN. C. R. Richmond, J. E. Furchner, and W. H. Langham (Los Alamos Scientific Lab., N. Mex.). Health Phys., 8: No. 3, 201-5(June 1962).

The Los Alamos 4π liquid scintillation counter (Humco 1) was used to measure whole-body retention of radiocesium in four adult male subjects. Two subjects were measured for about 550 days and one for 940 days. The whole-body retention data were reduced into two-component exponential equations by a curve-fitting method programmed for an IBM Model 704 computer. The biological half-time of the important retention component ranged from 110 to 147 days, with a mean value of ~135 days, for the four subjects. Standard deviations are given for the retention parameters. Results of other investigators are presented. (auth)

18739 Cs^{137} DOSE MEASUREMENTS IN TISSUE. [PART] I. D. N. Tapper, M. M. Nold, and C. L. Comar (Cornell Univ., Ithaca, N. Y.). Health Phys., 8: No. 3, 207-16(June 1962).

A method was developed whereby the contribution of both the β- and γ-emissions of the Cs^{137} radionuclide to soft-tissue absorbed-radiation dose can be measured. This involves the use of shielded and unshielded silver-activated phosphate glass rods, the former receiving only the γ-exposure and the latter the combined exposure. The fluorescent response of the dosimeter per unit energy absorbed in the adjacent water medium from the Cs^{137} γ-emission was found to be the same as the fluorescent response of the rods per rad in surrounding lucite when the exposure was made with an external sealed Co^{60} source. The rod fluorescence per unit energy deposition in the surrounding water produced by the Cs^{137} β-emission was only one-seventh that of the γ-component. Exposure of the dosimeter rods in aqueous solutions of pure β-emitters indicated that the fluorescence produced in the rods per rad in the solution appeared to be an increasing, possibly linear, function of the average β-energies of the various nuclides. These results suggest that this dosimeter is not a point detector for β-particles and that, in terms of the rod fluorescent response to these emissions per unit absorbed dose in the surrounding medium, an energy dependence is observed which may be a consequence of range-energy relationships. (auth)

18740 Cs^{137} DOSE MEASUREMENTS IN TISSUE. [PART] II. M. M. Nold, D. N. Tapper, and C. L. Comar (Cornell Univ., Ithaca, N. Y.). Health Phys., 8: 217-29 (June 1962).

The silver phosphate glass dosimetry system was used to measure the β and γ radiation dose from Cs^{137} to the testicles, muscle, liver, and kidneys of dogs. The size of the dosimeter rods (1 × 6 mm) permitted surgical placement within the tissues, and use of lucite shields allowed measurement and comparison of the β and γ exposure relationships from known amounts of the ingested radioactivity. Two groups of dogs were used in the in vivo experiments. One group was given a single meal of Cs^{137} and killed after 28 days. The second group was given the radioactivity daily for a 56-day period. Blood and muscle biopsies were taken for determination of radioactive concentrations throughout the exposure periods, and extensive tissue sampling was done at autopsy. The β-dose to muscle, when calculated from concentration–time data, compared favorably with that measured with dosimeters. It was estimated that gonads would receive a radiation dose of 0.05 to 0.10 rad/μc Cs^{137} ingested when calculated with an exposure time of 1 year. No difference in the delivered radiation dose per microcurie ingested was observed between the two groups. Extrapolation of the dog data to man was made. It is calculated from the data that an intake of 80–160 μc Cs^{137} would deliver the maximum permissible dose (MPD) of 5 rads/year. This range spans the 110–160 μc Cs^{137} estimate for standard man computed from NBS Handbook 69 values. (auth)

18741 APPENDIX TO Cs^{137} DOSE MEASUREMENTS IN TISSUE. [PART] IIA. AN ACCUMULATION MODEL FOR REPEATED EQUALLY SPACED FEEDINGS OF RADIONUCLIDES OF THE Cs^{137} TYPE. Daniel N. Tapper and Nancy L. Tapper (Cornell Univ., Ithaca, N. Y.). Health Phys., 8: No. 3, 231-2(June 1962).

A method is presented for analysis of the total accumulation curve for radionuclides of the Cs^{137} type for use in the evaluation of the retention pattern in animals. The method is a modification of a component-analysis method. (C.H.)

18742 DESIRABILITY OF EXPRESSING CONCENTRATIONS OF MINERAL-SEEKING CONSTITUENTS OF BONE AS A FUNCTION OF ASH WEIGHT. R. B. Holtzman (Argonne National Lab., Ill.). Health Phys., 8: 315-19(June 1962).

Problems are discussed that are encountered in describ-

ing the concentrations of chemical elements in bone. It is pointed out that concentrations are usually expressed relative to the fresh, wet, ash, calcium, dry, or dry fat-free weight of bone. It is shown that for mineral-seeking elements the concentration should be given in terms of the ash weight. Data are tabulated showing the ash-to-wet-weight ratios of several types of bone measured by several observers in various laboratories. Large variations were found in some samples. It is emphasized that for the purpose of measuring absorbed dose, the concentration in wet tissue must be used since it is necessary to abide faithfully to in vivo conditions. (C.H.)

18743 POSSIBILITIES FOR THE APPLICATION OF ISOTOPES IN PHARMACOLOGICAL STUDIES. Yves Cohen (Centre d'Étude Nucléaires, Saclay, France). Minerva nucleare, 6: 1-8(Jan. 1962). (In Italian)

The possibilities and difficulties in the application of nuclear physics in the field of pharmacology are considered. The methods applied in these studies are physical, but often involve the principles of nuclear chemistry; the results are biological, and are the grounds for medical applications. As physiology had to base itself on biochemistry and electronics in order to progress, so modern pharmacology must be based on nuclear chemical studies. (auth)

18744 THE TRANSPORT OF PARTICLES ACROSS THE WALLS OF SMALL BLOOD VESSELS. Margaret A. Jennings, V. T. Marchesi, and Howard Florey (Sir William Dunn School of Pathology, Oxford). Proc. Roy. Soc. (London), B156: 14-19(May 15, 1962).

Colloidal particles of thorium dioxide and saccharated iron oxide and molecules of ferritin enter the vesicles of the endothelium of the perfused rat heart. The first two substances have been shown to pass within the vesicles through the cells of the endothelium into the perivascular spaces. (auth)

18745 A LIST OF MUTANT GENES IN ARABIDOPSIS THALIANA (L.) HEYNH. A. D. McKelvie (Plant Breeding Inst., Cambridge, Eng.). Radiation Botany, 1: 233-41 (Apr. 1962).

As part of a program to study the induction of mutations in Arabidopsis thaliana (L.) Heynh. by radiation or by mutagenic chemicals, 190 mutant genes was named and described. These genes have been shown by crossing tests to be distinct and each one embodies an easily detectable morphological character. This list is intended as a starting point for the classification of Arabidopsis genes and for the construction of a chromosome map. (auth)

18746 SPECTROPHOTOMETRIC REMISSION MEASUREMENTS ON HUMAN SKIN IN THE REGION OF 220 TO 2500 nm. Heinrich Pfleiderer (Universität, Kiel). Strahlentherapie, 117: 601-7(Apr. 1962). (In German)

Measurements of the spectral skin remission, limited to the diffuse portion of the back scattering shows very well the details of the absorption-spectrum of deeper skin layers Technical problems about measurement of remission are discussed. The modification of the remission spectrum by the pigment of Europeans and Negroes is shown mostly by a breaking up of the short wave portion of the remission curve. The peak is displaced toward the long wave portion. The causes of the different absorption bands are discussed. The remission for dry skin is increased especially in the UV and IR regions. (auth)

18747 NOTIONS DE RADIOBIOLOGIE. (Concepts of Radiobiology). Henry Roux. Paris, Masson et Cie, 1960. 175p.

Radiobiology is a discipline that includes physics, chemistry, and biology. The present book, written for the college student, describes as simply as possible the basic concepts of radiobiology. The topics discussed include atoms and associations of atoms, molecular fragments, molecular transformations induced by ionizing radiation, radiochemistry of some systems, dosimetry, biological effects of ionizing radiations, and dangers of radiation and protection against them. (J.S.R.)

Biochemistry, Nutrition, and Toxicology

18748 (TID-15685) A STUDY OF THE DEPOSITION AND RETENTION OF PLUTONIUM DIOXIDE IN RATS (thesis). Bruce B. Boecker (Rochester, N. Y. Univ.). 1959. 118p.

Four groups of six 150 to 175 g female rats were exposed for 45 minutes to a PuO_2 aerosol generated by aspiration of an aqueous PuO_2 suspension. Particle size measurements made with a point-to-plane electrostatic precipitator and an electron microscope indicated the aerosol had a count median diameter of 0.19μ with σ_g = 2.08. Samples of the air concentration using Millipore filters during exposure indicated an activity range of 65-89 dis/min/cc for the 4 exposure runs. Several variations of a plutonium analytical method using the direct mixing of the tissue digest solution and silver activated ZnS were studied. The wet ZnS method was found to be unsatisfactory for all tissues except lungs due to tissue ash interference with the ZnS. It was found that drying the samples immediately after shaking the ZnS and tissue digest solution mixture gave satisfactory results. Recoveries from tissues "spiked" with plutonium prior to wet digestion with concentrated HNO_3 yielded a mean recovery figure of 95% with a standard deviation of 9.4%. This method proved to be very useful and also quite time-saving. The lower level of significance was 220 disintegrations per minute for a 2 ml. aliquot of a 50 ml. digest solution. (auth)

18749 (UCRL-10045) ENERGY CAPTURE AND CONVERSION BY PHOTOSYNTHESIS. J. A. Bassham (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1962. Contract W-7405-Eng-48. 34p.

The capture and conversion of energy by photosynthetic plants are discussed. Green plants absorb light and use its energy to separate some of the oxygen from its oxides and to form organic compounds from the remaining atoms. The relations between photosynthesis and respiration are shown. Equations are given for the formation of organic compounds and the storage of chemical potential energy. The carbon reduction cycle is discussed. The conversion of light or electromagnetic energy into chemical potential and the consequent production of cofactors in their reduced and more energetic forms are described. The quantum requirement for photosynthesis is considered. (auth)

18750 BEHAVIOR OF RADIOZINC IN RAT PLASMA. J. P. Okunewick, B. Pond, and T. G. Hennessy (Univ. of California, Los Angeles). Am. J. Physiol., 202: 926-30 (May 1962).

This series of studies was undertaken to determine the behavior of Zn^{65} when injected intravenously into rats as the inorganic ion. A clearance curve for Zn^{65} similar to those of other workers was obtained. It was found that the decrease in clearance and distribution of Zn^{65} was not in direct proportion to the decrease in specific activity. Upon extraction of loosely bound zinc from plasma with dithizone-

acetone virtually all of the injected Zn^{65} could be removed up to 1 hr after intravenous injection. However, extraction of the unbound zinc ion demonstrated that more than 90% of the Zn^{65} is bound to protein within the first 3 min after addition of Zn^{65}. Dialysis of Zn^{65} against plasma protein showed the Zn^{65} ion is removed by plasma from solution by direct binding to nondialyzable plasma components. Irradiation of rats with supralethal dosages of x ray followed by subsequent injection of Zn^{65} demonstrated that clearance of Zn^{65} from plasma is unaffected by this major alteration of the metabolic state of the animal. (auth)

18751 GROWTH OF AZOTOBACTER IN DEUTERIUM OXIDE. D. B. Johnstone (Univ. of Vermont, Burlington). J. Bacteriol., 83: 867-70(Apr. 1962).

To the small list of bacteria that are reported to have been cultured in fully deuterated media can be added Azotobacter agilis and A. vinelandii. Moreover, these bacteria, although growing in a deuterium oxide medium with deuterated carbon sources, will fix atmospheric nitrogen. Lag periods occur prior to growth, and wide morphological variation is apparent during adaptation to a deuterated environment. A convenient method is presented for measuring, by infrared spectroscopy, the amount of water that accumulates in a D_2O medium; during incubation this amounts to about 1% per day. Prevention of this accumulation of water indicates that growth, after a lag period, probably is not supported by accumulated hydrogen. (auth)

18752 TOXIC EFFECTS OF STABLE STRONTIUM IN YOUNG PIGS. J. C. Bartley and E. F. Reber (Univ. of Illinois, Urbana and Illinois Agricultural Experiment Station, Urbana). J. Nutrition, 75: 21-8(Sept. 1961).

The metabolism and toxic effects of strontium in pigs, three to 8 weeks old, were investigated. Hampshire pigs were fed a synthetic ration containing 0.55% of calcium or 0.16% of calcium and 0.47% of strontium. In another experiment a factorial design was used in which 0.89 or 0.16% of calcium and zero or 0.67% of strontium were included in the rations. The pigs fed strontium and 0.16% of calcium were the most severely affected by incoordination and weakness followed by posterior paralysis. Occasionally mild toxic effects were observed in the pigs fed 0.89 or 0.55% of calcium and strontium. One pig fed 0.16% of calcium was mildly affected by the treatment. The bone deformities seen grossly, radiographically, and microscopically were most marked in pigs fed strontium and 0.16% of calcium. There was widening of the epiphyseal plates and cupping of the metaphyses. Radiographically, the margins of the epiphyses were poorly delineated and radiolucidity was marked. The microscopic examination revealed cartilage remaining in the metaphyses and a marked increase in osteoid tissue. When 0.55 or 0.89% of calcium was included in the ration the weight gain, feed efficiency, bone ash, bone total solids, bone calcium and bone strontium were significantly increased as compared with pigs fed 0.16% of calcium. Feeding strontium depressed calcium and fat content of bone. The results are discussed in respect to present knowledge of strontium, calcium, and bone metabolism. (auth)

18753 THE USE OF RADIOACTIVE PHOSPHORS (P^{32}) IN THE DIAGNOSIS OF CANCER OF THE PORTIO VAGINALIS. M. F. Becchini, A. Zacutti, and G. Turchetti (Università, Pisa, Italy). Minerva nucleare, 6: 23-7(Jan. 1962). (In Italian)

The radioactivity of the portio vaginalis was measured with a Geiger-Müller tube at various times after an intravenous injection of 3 μc of radioactive phosphorus per kg of body weight in normal subjects and in patients with various diseases (erosions, polyps, cancer) of the portio. An increased uptake of P^{32} in vivo was observed in neoplastic as compared with normal tissues. This difference was most significant from the 48th to 72nd hour. During this time the values measured over cervical erosions and polyps did not exceed the range of variability in the normal cases. This method can therefore be used to detect cancerous areas in the neck of the uterus and to determine their localization with good precision. (auth)

18754 LE RADIOCALCIUM DANS L'ETUDE DES OS. (Radiocalcium in the Study of Bone). R. Ponlot. Brussels, Editions Arscia S. A. and Paris, Masson et Cie, 1960. 254p.

Since 1955 an extensive study has been made of the mineral portion of the bone with the aid of Ca^{45}. The results of this study are presented. The topics discussed include autoradiography of Ca^{45}, compact bony tissue, the Haversian modification, reading of the Ca^{45} autoradiograph at the end of various time periods, interpretation of the autoradiograph calcium content of the tibia, humerous, and spinal column, and concepts of osteones. (J.S.R.)

Fallout and Ecology

18755 RADIOACTIVE AIR-BORNE DUSTS IN JAPAN. T. Mamuro, A. Fujita, T. Matsunami, K. Yoshikawa, and T. Azuma (Radiation Centre of Osaka Prefecture, Sakai). Nature, 194: 643-4(May 19, 1962).

In order to find the reason for differing radioactivity of rainwater samples collected at nearby laboratories at the same time in the fall of 1961, autoradiographs were made of the air-borne dusts collected on large filter papers. Some of the resulting spots were extremely active, and it is concluded that the rainwater discrepancy is due to a small number of highly radioactive particles in fall-out. Autoradiographs were also made on wild arrowroot leaves. Gamma spectra of a dust sample and of a particle found on a polyethylene bottle left outdoors are given. (D.L.C.)

18756 CAESIUM-137 IN THE SEAS OFF THE CAPE OF GOOD HOPE. B. W. Schroeder and R. D. Cherry (Univ. of Cape Town). Nature, 194: 669(May 19, 1962).

Five samples were collected from the waters off the Cape of Good Hope in August and September 1961 prior to the Russian tests and analyzed for Cs^{137}. The Cs^{137} content ranged from 29 to 161 μμc/kl with a 95% confidence limit of ±25 μμg/kl, and the average is 90 ± 47 μμc/kl, which is significantly lower than the Cs^{137} contents reported for northern oceans. (D.L.C.)

Radiation Effects on Living Tissues

18757 (AMRL-532) THE SEROLOGICAL SPECIFICITY OF RADIATION ALTERED HUMAN SERUM GAMMA GLOBULIN. Anthony J. Luzzio (Army Medical Research Lab., Fort Knox, Ky.). Mar. 19, 1962. 24p.

Human serum gamma globulin after intense in vitro x irradiation was used as an antigen to obtain antiserums in goats. It was found to be distinct immunologically from nonirradiated or heated human serum gamma globulin by quantitative precipitin tests and possessed a slow moving component as determined by paper strip electrophoresis. Similar antigens were produced by irradiating human serum in vitro with low doses. Preliminary evidence points to the possibility of detecting irradiation-altered proteins in the irradiated patient by quantitative immunological methods. (auth)

18758 (BNL-715) A DESCRIPTIVE TECHNIQUE FOR STUDY OF THE EFFECTS OF CHRONIC IONIZING RADIATION ON A FOREST ECOLOGICAL SYSTEM. George M. Woodwell and E. Cuyler Hammond (Brookhaven National Lab., Upton, N. Y.). Mar. 1962. Contract [AT(30-2)-Gen-16]. 15p.

A representative Long Island oak-pine forest was irradiated experimentally with chronic γ radiation from a single, centrally located Cs^{137} source. A detailed plan is described for recording phytosociological information prior to and subsequent to initiation of the irradiation and for transcribing the data onto IBM punch cards. (C.H.)

18759 (NP-11660) QUARTERLY PROGRESS REPORT NO. 43 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). Apr. 15, 1962. Contract AF 41(657)-252. 105p.

Research progress in radiobiology is presented in 8 papers. Topics covered include pharmacological and toxicological compounds as protective or therapeutic agents against radiation injury in experimental animals, influence of exposure to low levels of gamma and fast neutron irradiation on the life span of animals, and the effects of ionizing radiations on the biochemistry of mammalian tissues. Separate abstracts were prepared for each paper. (M.C.G.)

18760 (NP-11660(p.1-15)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. DOSE-MORTALITY RELATIONSHIPS FOR THE TOXIC AND RADIOPROTECTIVE EFFECTS OF VARIOUS CHEMICAL AGENTS. V. Pizak, J. Doull, and M. Root (Chicago. Univ. Air Force Radiation Lab.).

The comparative radioprotective activity of 1-thioglycerol (B-40), ethyl isothiourea hydrochloride (EL-18) and S-(n-butyl) isothiourea hydrochloride (EL-89) was investigated in CF_1 male mice given whole-body x-ray exposures in the range from 600 through 900 r. Using a log-probit transformation of the mortality data to compute the exchange in LD_{50} (30 days), it was found that the dose reduction factor (IRF, administered dose in r/effective dose in r) for 1-thioglycerol was 1.20. S-(n-butyl) isothiourea and ethyl isothiourea gave DRF values of 1.32 and 1.39 respectively. The acute toxicity of a number of effective radioprotective agents was investigated and LD_{50} (21-day) values for each agent were determined from the regression lines obtained by graphing the dose-mortality data. Female mice were found to be about half as susceptible as males to the toxic effects of p-aminopropiophenone and preliminary studies indicated that the toxicity of this radioprotective agent can be influenced appreciably by environmental temperature conditions. The use of a combination of 2-mercaptoethylamine and p-aminopropiophenone was found to be more effective in preventing radiation lethality in x-rayed mice than the single administration of either agent. Combinations of a number of other radioprotective agents were toxic at dosage levels considerably less than was expected from the toxicity of the individual agents. (auth)

18761 (NP-11660(p.16-41)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Pizak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

The results of toxicity and radioprotective evaluation studies on 60 additional chemical compounds in male CF_1 mice are presented. Eleven of these compounds were found to exhibit significant radioprotective activity in that they reduced the 30-day mortality of the x-rayed mice or increased the ST_{50} (median survival time) by more than five days over that of the control irradiated animals. The most marked radioprotective effect was obtained with 2,2'-dithio-bis-(ethylamine) hydrochloride (CB-34) which permitted 100% of the lethally irradiated mice to survive for the 30-day observation period when given at a dosage level of 300 mgm/kgm. Reducing the dosage level of this compound of 200 mgm/kgm reduced the 30-day survival to 30%. Acrylonitrile (EK-P-5161) administered at a dosage level of 50 mgm/kgm protected 80% of the animals from the lethal effects of the x-ray exposure and 50% of the mice pre-treated with glyoxal (EK-T-4485) survived when this compound was administered at a dosage level of 500 mgm/kgm. Increasing the dosage level of glyoxal to 500 mgm/kgm decreased the number of 30-day survivors. Seventy per cent of the mice given 500 mgm/kgm of butanone oxime (EK-906) survived for 30 days after the lethal x-ray exposure but the protective effects of this compound were not increased with either higher or lower dosage levels. Two of the compounds included in the study permitted 30% of the irradiated mice to survive the radiation exposure: pulegone (EK-6739) at a dosage level of 50 mgm/kgm and 1-[p-(phenylazo) phenyl]-2-thiourea (K-1461) at a dosage level of 100 mgm/kgm, 1-o-Tolyl-2-thiourea (K-1453), naphthoresorcinol (S-5), and 1-isopropyl-4,4-dimethyl-2-imidazolinethione (CS-36) all permitted 20% of the animals to survive for 30 days after the lethal x-ray exposure and 10% of the mice pretreated with propionitrile (EN-528) and 3-hydroxycinchoninic acid (UCTL-16) survived for this period. (auth)

18762 (NP-11660(p.42-58)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. EFFECT OF ATHEROGENIC DIETS ON THE RESPONSE OF RATS TO CHRONIC X-IRRADIATION. D. Vesselinovitch, J. Doull, R. W. Wissler, and J. Meskauskas (Chicago. Univ. Air Force Radiation Lab.).

The influence of various atherogenic and high-fat diets on the survival time, body, weight, food consumption, and blood lipids of adult male Sprague Dawley rats exposed to chronic x-irradiation was investigated. The four experimental diets employed for these studies produced a severe stress in both the control and irradiated groups as indicated by the failure of the animals to exhibit a normal growth rate and by the significant shortening of their life span in comparison with rats fed a control diet. Daily exposure to 20 r of whole-body x-irradiation (five days a week) for twelve weeks significantly shortened the median survival time of animals fed either the Thomas or Fillios diets and the effect was more pronounced when the daily x-ray exposure was increased to 40 r per day. Animals fed the Wissler and Wilgram diets exhibited a slightly greater median survival time than animals fed a control diet when exposed to 20 r per day but there was no indication of a protective effect when the x-ray exposure was increased to 40 r per day. There was a marked elevation in the serum lipid level and serum cholesterol and phospholipid levels of animals fed the Thomas, Fillios and Wilgram diets for twelve weeks. Exposure to 20 r or 40 r of x-irradiation per day suppressed these diet-induced changes in blood lipid levels and this effect was most evident in the rats fed the Wilgram diet. (auth)

18763 (NP-11660(p.59-66)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS.

II. STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies on the mortality of male and female rats given praseodymium nitrate by intravenous injection showed that there is a sex difference with respect to the toxicity of this compound. Approximate LD_{50} values of 2.4 and 15.0 mgm/kgm of praseodymium were obtained in female and male rats, respectively. The LD_{50} values of 13.0 mgm/kgm in females and 19.0 mgm/kgm in males for erbium shows that this representative member of the heavy lanthanons does not exhibit an appreciable sex difference in toxicity. Approximate LD_{50} values of 1.4 mgm/kgm for cerium, 2.1 mgm/kgm for neodymium, 3.0 mgm/kgm for samarium, and 31.0 mgm/kgm for holmium were obtained when the nitrate salts were administered by intravenous injection to female rats. Intravenous administration of 2.0 mgm/kgm of praseodymium nitrate alone or in combination with 300 r of whole-body x-irradiation had no effect on adenosine triphosphatase activity of liver and spleen of female rats at 24 and 48 hours after injection. There was a slight decrease in enzyme activity of doubtful significance under the conditions of these experiments. (auth)

18764 (NP-11660(p.67-75)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. III. EFFECT OF DOSE RATE ON LIFE SPAN SHORTENING OF MICE EXPOSED TO CHRONIC GAMMA AND FAST NEUTRON IRRADIATION FOR ONE YEAR. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Mortality data obtained during the first year of a duration of life chronic gamma and fast neutron irradiation programs are presented and compared with the results of previous studies. The life span shortening in CF_1 female mice exposed to chronic gamma irradiation at dose rates of 7, 24, 43, and 88 rep/day appears to be linearly related to the log of the daily radiation dose rate. The mean dose of gamma irradiation accumulated by the median survival time was highest in the groups exposed to 24 and 43 rep/day and lowest in the animals exposed to gamma radiation at a dose rate of 7 rep/day. (auth)

18765 (NP-11660(p.76-84)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF RATS. Bernard E. Hietbrink, Betty A. Ryan, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies were undertaken to determine the effect of x-irradiation on the development of the drug metabolizing enzyme in the livers of young male rats. It was found that the development of the enzyme activity of the livers of rats that were exposed to 200 or 400 r of x rays at 23 days of age was markedly inhibited. Evidence was obtained to indicate that the inhibitory effect observed was not a result of prolonged starvation or a deficiency of necessary cofactors. Daily injections of 2 mgm/kgm of testosterone propionate increased the rate of development and activity of the enzyme in the non-irradiated rats. Testosterone injections caused a moderate stimulation in the enzyme activity of rats given 200 r at 23 days of age but did not alter the inhibitory effect of 400 r x rays. Initial studies on the influence of shielding various organs on the inhibitory effect of x rays on the development of the drug metabolizing enyzme indicated that shielding the testes does not reduce the degree of radioinduced inhibition. (auth)

18766 (NP-11660(p.85-95)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. CUMULATIVE TOXIC EFFECTS OF REPEATED DOSES OF AMINOETHYLISOTHIURONIUM DIBROMIDE AND DIMETHYLAMMONIUM DIMETHYLDITHIOCARBAMATE. Kenneth P. DuBois, Ann B. Raymund, and Bernard E. Hietbrink (Chicago. Univ. Air Force Radiation Lab.).

A study was made of the influence of daily administration of 100 mgm/kgm of AET (Aminoisothiuronium dibromide) and the same dose of dimethylammonium dimethyldithiocarbamate on the pyruvic dehydrogenase activity of the liver and kidney of rats. During the first week of treatment the enzyme activity of the liver was inhibited to the extent of 13 to 35% on the basis of measurements of oxygen consumption and 20 to 35% on the basis of inhibition of the utilization of pyruvate. The amount of inhibition did not increase further during 26 days of treatment. Since neither of these compounds inhibit the enzyme activity of the liver when given alone at the same dosage level, it was apparent that they exerted an additive toxic effect when administered simultaneously. A daily dose of 100 mgm/kgm of each compound produced 7 to 16% inhibition of the oxygen consumption by kidney and 10 to 30% inhibition of pyruvate utilization during the first seven days of treatment but the amount of inhibition in this tissue increased to 37% on the basis of oxygen consumption and to 45% on the basis of pyruvate utilization after 20 days of treatment. Since 100 mgm/kgm of AET given daily does not inhibit the pyruvic dehydrogenase activity of the kidney, it appears that the dithiocarbamate renders the pyruvic dehydrogenase system of the kidney more sensitive to inhibition by AET. When rats were given 150 mgm/kgm of AET and the same dose of the dithiocarbamate at daily intervals, oxygen consumption by the liver was inhibited 46% after seven days of treatment. Animals maintained at this dose level for 20 days exhibited no further amount of inhibition. This dose of the compounds caused 28% inhibition of oxygen consumption and 42% inhibition of pyruvate utilization after seven days of treatment and no further increase occurred after 20 days of treatment. The results of these measurements demonstrated that the enzyme activity of both tissues exhibited more inhibition than would have been noted with the same doses of either compound given separately. The administration of 200 mgm/kgm of AET and the same dose of dimethylammonium dimethyldithiocarbamate resulted in a rapid decrease in pyruvate utilization to the extent of 44% in liver and 49% in kidney in two days and high mortality of these animals occurred with prolonged treatment at this dose level for several days. (auth)

18767 (NP-11660(p.96-103)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES. Bernard E. Hietbrink, Ann B. Raymund, and Betty A. Ryan (Chicago. Univ. Air Force Radiation Lab.).

A study was conducted to determine the radioprotective activity of butyl alcohol, an agent which stimulates hematopoiesis. Daily doses of 5 or 10 mgm/kgm of butyl alcohol produced a substantial increase in the size of the spleen. Administration of butyl alcohol after exposure to 400 r did not reduce the radioinduced changes in the adenosine triphosphatase activity of the thymus glands or in the cholinesterase activity of the intestine. However, injections of 10 mgm/kgm of the compound immediately and 24 and 48 hours after 400 r of x rays caused a 34% reduction

in the biological effect of radiation in the spleen. The effect of sodium pentobarbital on the radioprotective activity of cysteine was investigated. Pentobarbital was given before and after injections of cysteine or after exposure to x-irradiation. In all instances the administration of pentobarbital reduced the radioprotective activity of cysteine. The combination of 30 mgm/kgm of pentobarbital with 225 mgm/kgm of MEA (2-mercaptoethylamine) failed to reduce the injurious effects of radiation to the extent that 200 mgm/kgm of MEA did when administered alone. (auth)

18768 (TID-15697) HISTOPATHOLOGICAL EFFECTS OF X-IRRADIATION OF THE TRANSPLANTED ADRENAL CORTEX ON SHIELDED LYMPHATIC ORGANS IN RATS (thesis). Alison T. Provoost (Rochester, N. Y. Univ.). 1953. 90p.

A study was made of the response of shielded lymphatic tissue to direct x irradiation of the nonmedullated adrenal gland, by transplanting adrenal tissue to the legs of rats, where it would easily be irradiated, free from the radiosensitive tissues of the abdomen and from abdominal nerve tissues that may mimic the medulla. Methods and materials are described including surgical procedures, animals and animal maintenance, radiation, clinical observations, sacrifice schedule, postmortem dissection and examination, tissue preparation, and histological examinations. Doses of 1500 to 2000 r were delivered to the legs. Data indicated that the atrophic effects in the shielded thymus were probably mediated indirectly through the adrenal cortex, and were not produced through the direct effects of irradiation of the transplanted adrenal cortex. The atrophic effects in the lymphatic tissue of the shielded spleen were produced largely by direct irradiation of the adrenal cortex rather than by indirect mediation through the adrenal cortex. It was concluded that some of the splenic lymphatic change may be produced indirectly by some means independent of the adrenal. The adrenal, with the ordinary staining methods used, revealed no destructive cellular changes. (M.C.G.)

18769 (USNRDL-TR-562) THE EFFECT OF WHOLE BODY X-IRRADIATION ON BLOOD PRESSURE IN THE RAT. R. D. Phillips and D. J. Kimeldorf (Naval Radiological Defense Lab., San Francisco). May 8, 1962. 28p.

Blood pressure was measured at a peripheral and central site in the rat. Pressure at the peripheral site was determined by a tail occlusion cuff method, while central pressure was measured by aortic intubation. There was marked decrease in blood pressure measured at the peripheral site 8 hr after the animals were exposed to 485 rads of x rays, with a return to control values by 3 days after exposure. Aortic blood pressure, however, was not altered at this dose level. There was a mild decrease in aortic pressure 24 and 48 hr after 970 rads and marked hypotension 8 and 24 hr following 1940 rads. The aortic blood pressure response to various stimuli was also altered after 970 rads, but not after 485 rads of x rays. These data demonstrate that blood pressure at a peripheral site can be decreased at a dose level which does not affect central pressure. It is suggested that this differential effect in blood pressure is a result of a radiation response in peripheral circulation. (auth)

18770 (AEC-tr-4956) LEUKEMIA AS POSSIBLE COMPLICATION OF IRRADIATION THERAPY IN CERVICAL CARCINOMA. M. Thiery and S. Ringoir. Translated from Belg. Tijdschr. Geneesk., 17: No. 10, 524-30(1961). 11p.

A case of acute leukemia which developed after radiation therapy in cervical carcinoma is described. A survey made of the effects of radiation on leukemia is discussed in connection with this special case. It was not possible to establish a causal connection between the patient's acute leukemia and the x-ray treatment which preceded it. (auth)

18771 POSTRADIATION OSTEOGENIC SARCOMA. REPORT OF A CASE AND REVIEW OF LITERATURE. Claude Bloch (Mount Sinai Hospital, New York). Am. J. Roentgenol., Radium Therapy Nuclear Med., 87: 1157-62 (June 1962).

A case of pelvic osteogenic sarcoma is presented, occurring 14 years after radiation therapy for carcinoma of the cervix. No previous similar case has been described in the literature on radiation treatment for carcinoma of the cervix. The clinical and experimental literature on postradiation osteosarcoma is reviewed. (auth)

18772 EFFECTS OF GAMMA RADIATION ON POLYMER IN SOLUTION. II. POLY(VINYL METHYL ETHER). Ichiro Sakurada and Yoshito Ikada (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 16-24(Mar. 1962). (In English)

Polyvinylmethyl ether was degraded more easily in better solvents when irradiated in dilute air-free organic solutions except in carbon disulfide, but in higher concentrated solutions crosslinking proceeded more readily in solvents of lower viscosity. Gel was formed even at concentrations below 1 wt % in carbon disulfide; the critical concentration for gel formation was nearly equal to that of an aqueous solution. The critical concentration in the case of polystyrene in carbon disulfide solution was about 0.15 wt %. On the basis of the observed results, a role of solvent at the irradiation of polymer in solution was discussed in considerable detail, and it was found that the mechanism of radioinduced reactions could be satisfactorily explained in terms of formation or deactivation of macroradicals by the solvent radicals, and change in the rate of the coupling or the cage-recombination reactions caused by the increase in mobility, dilution, and solvation of polymers due to the solvent. (auth)

18773 DECREASE OF THE CUTANEOUS RADIOSENSITIVITY FOLLOWING IRRADIATION WITH DIFFERENT FIELDS, AT AN INTERVAL OF SEVERAL DAYS. Jean Loiseleur, Liliane Catinot, and Annik de Vomecourt. Compt. rend., 254: 1339-40(Feb. 12, 1962). (In French)

Irradiation, at intervals of several days, of different areas of the skin causes at the same time the rapid healing of radiolesions following each irradiation and a decrease of the radiosensitivity which persists for several weeks in all the cutaneous tissue. (tr-auth)

18774 THE EFFECT OF THE IRRADIATION ON PREGNANT ANIMALS WITH X-RAYS ON THE PERIPHERAL BLOOD CHANGES IN THE PROGENY. N. I. Nuzhdin, N. N. Kuznetsova, and L. K. Ramaiya (Inst. of Genetics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 143: 717-20(Mar. 21, 1962). (In Russian)

Pregnant white mice were given a single x-ray dose of 200 r each day on the 12th to 19th day of pregnancy. The amount of hemoglobin and the number of erythrocytes, reticulocytes, and leukocytes in the progeny were determined on the 1st, 10th, 30th, and 45th day of life. The maximum damage to the red blood cells was observed for irradiation on the 17th day of pregnancy. The reasons for the appearance of leucopenia and anemia in the 45 day old animals that had been irradiated on the 12th to 13th day of pregnancy are not clear, but it is believed that rudiments of the mesenchyme (lymphatic nodes, the spleen, and marrow)

are damaged during irradiation in this period of pregnancy. (TTT)

18775 INCREASE IN RADIORESISTIVITY OF NERVOUS TISSUE WITH THE USE OF THIAMINE COMBINED WITH A NARCOTIC. P. F. Minaev, P. Moshchinskii, and E. P. Skorobogatova (Inst. of Biochemistry and Inst. of Biological Physics, USSR). Doklady Akad. Nauk S.S.S.R., 143: 976-9(Apr. 1, 1962). (In Russian)

A dose of 9000 r was administered to the cerebellum of the guinea pig, and a dose of 20,000 r to the cerebellum of the dog. Thirty minutes before irradiation, 30 mg/kg of nembutol, 2 mg/kg of thiamine or of alinamine (the propyl disulfide derivative of thiamine), and 3 mg/kg of hexonine (a ganglion blocking agent) were given to the animals as protective agents. Irradiated animals who were not treated with protective chemicals showed a decrease of thiamine of 45% in the nerve tissue and also a decrease of thiamine in the liver, as compared to the unirradiated controls. The amount of pyruvic acid increased by 250% on the second day after irradiation. The level of thiamine remained unchanged in the animals who had been given the protective agents. The alinamine derivative was more effective than the administration of thiamine itself. A histological investigation showed less damage to the brain cells of the protected animals. The disorganization in cerebellum function was considerably less marked in the protected animals. (TTT)

18776 A NUMBER OF PHYSIOLOGICAL AND BIOCHEMICAL FEATURES OF MICE HAVING A VARYING NATURAL RADIOSENSITIVITY. N. I. Nuzhdin, I. A. Nechaev, B. M. Graevskaya, and R. N. Shchedrina. Doklady Akad. Nauk S.S.S.R., 143: 997-1000(Apr. 1, 1962). (In Russian)

The $LD_{50/30}$ dose was found to be 563 r for the Kryukovskii mice, 536 r for the CC_{57} brown mice, 457 r for the CH_3H (Rappolovo) mice, and 442 r for the VALV/c strain. The CC_{57} brown mice and the Dryukovo mice were found to have a large absolute and relative weight for the liver and spleen, and also a large goiter. No correlation could be found between the weight of the suprarenal glands or testis and sensitivity to ionizing radiation. Histochemical analysis showed that the content of catechol amines in the suprarenal glands was highest in the Kryukovskii mice, and lowest in the VALV/c mice. The more radioresistant line of mice also showed a lower content of glycogen in the liver. (TTT)

18777 METHAHEMOGLOBIN FORMATION FROM X RADIATION ON NORMAL AND CATALASE-FREE ERYTHROCYTES OF HUMANS. H. Aebi, J. P. Heiniger, and Hedi Suter (Universität, Bern). Experientia, 18: 129-30(1962). (In German)

Methahemoglobin formation in irradiated human red cells largely depends on catalase activity in either phase of the system. The formation rate is low in normal, but high in acatalatic cells. The latter rate can be lowered to normal by adding 0.1 γ/ml catalase to the suspending medium. (auth)

18778 ACCELERATED INDUCTION OF KIDNEY NEOPLASMS IN MICE AFTER X RADIATION (690 Rad) AND UNILATERAL NEPHRECTOMY. Victor J. Rosen, Jr. and Leonard J. Cole (Naval Radiological Defense Lab., San Francisco). J. Natl. Cancer Inst., 28: 1031-41(May 1962).

Groups of young adult $(C57L \times A)F_1$ mice were subjected to several different treatments including 690 rad whole-body x radiation, unilateral nephrectomy and no irradiation, 690 rad followed by unilateral nephrectomy 1 hour later, unilateral nephrectomy followed by 690 rad 3 hours later, and unilateral nephrectomy followed by 690 rad 48 hours later. The mice were examined 1 year or 18 months later for kidney neoplasms. The group nephrectomized and irradiated 3 hours later showed a high incidence (10 out of 19) of kidney adenomas, as compared with none in the mice irradiated only, or nephrectomized only. In addition, a high incidence (11 out of 15) of tubular and Bowman's capsule proliferations was observed in the mice subjected to irradiation first and nephrectomy 1 hour later. These proliferations are considered to be early stages in the development of the frank renal adenoma. The findings suggest that the occurrence of renal neoplasms in these x-irradiated mice was greatly increased as a consequence of the interaction of the specific proliferative stimulus (unilateral nephrectomy) on radiation-altered kidney cells. (auth)

18779 PRENATAL X-RAY EXPOSURE AND CHILDHOOD CANCER. Brian MacMahon (Harvard School of Public Health, Boston and Downstate Medical Center, Brooklyn). J. Natl. Cancer Inst., 28: 1173-91(May 1962).

This study was designed to test the hypothesis that in utero exposure to x ray in diagnostic doses increases subsequent mortality from neoplastic disease during childhood. The study population consisted of 734,243 children born in and discharged alive from any of 37 large maternity hospitals in the Northeast United States in the years 1947 to 1954. The frequency of intrauterine x-ray exposure in the population was estimated by review of the records of a 1 percent systematic sample. Abdominal or pelvic x rays were recorded in 770 (10.6%) of the 7,242 single pregnancies in the sample. Five hundred and eighty-four children born in the study population who subsequently died of cancer were identified by review of death and birth certificates in the Northeast Region. The records of pregnancy and delivery of 569 of these children were also reviewed. Eighty-five (15.3%) of the 556 cancer deaths born of single pregnancies had intrauterine x-ray exposure. The higher frequency of prenatal x ray in the cancer cases than in the sample was statistically significant. After correction for indirect associations with birth order and other complicating variables, it was estimated that cancer mortality was about 40 percent higher in the x-rayed than in the unx-rayed members of the study population. This relationship held for each of the three major diagnostic categories—leukemia, neoplasms of the central nervous system, and other neoplasms. The excess cancer mortality in the x-rayed group was most marked at ages 5 through 7 years, at which time the relative risk was 2.0. The excess risk apparently was exhausted by age 8. A trend toward higher mortality in the more heavily exposed children was small and not statistically significant. No significant variation with stage of pregnancy at exposure was evident. The association of intrauterine x-ray exposure with cancer mortality does not explain the high incidence of leukemia in first births noted previously. (auth)

18780 GROWTH AND DIETARY PATTERN OF RATS FED SELF-SELECTION DIETS FOLLOWING WHOLE-BODY IRRADIATION. Frank Konishi (Naval Radiological Defense Lab., San Francisco). J. Nutrition, 75: 192-6(Oct. 1961).

The apparent ability of rats to voluntarily select a diet according to the needs of the body was used in this study to detect possible metabolic derangements subsequent to a dose of 375-rad whole-body x irradiation. The animals were allowed free choice selections of various foodstuffs offered in separate containers and the relative amounts of food intake as well as body weights were measured daily. The majority of the rats were able to select diets sufficiently adequate to support normal growth. Upon irradiation at the level used, rats fed a basal premixed diet lost

significantly more body weight than similarly treated rats selecting their own diet. In the over-all pattern, the proportion of casein selected increased progressively, whereas that of sucrose decreased subsequent to the irradiation. The selections of yeast and corn oil remained essentially the same. On the third day only, after irradiation, the intake of minerals increased to over 5 times the pre-irradiation level. The selection and intake of casein returned to pre-irradiation levels by the third day, whereas the total caloric intake of irradiated rats fed basal and self-selected diets returned to normal levels by the 5th day. Possible explanations for the apparent craving for casein and minerals after the level of irradiation used are discussed briefly. (auth)

18781 EFFECTS OF HETEROGENEOUS POPULATIONS ON RADIATION SURVIVAL CURVES. William C. Dewey and Arthur Cole (Univ. of Texas, Houston). Nature, 194: 660-2(May 19, 1962).

An equation representing the survival of homogeneous cell populations on radiation exposure is $S = 1 - (1 - e^{-D/D_0})^n$, where S is the fraction of the population surviving the dose D and $n \geq 1$. An analysis of the effect of heterogeneity on the shape of survival curves is made for populations divided into groups with different D_0 but same n. Equations for heterogeneous populations are derived by binomial expansion of the form of the above equation for the heterogeneous case. Various possible combinations of two populations with differing radiosensitivity are considered, and criteria are developed for detecting heterogeneity in survival curves. (D.L.C.)

18782 INTERACTION OF THE OXYGEN EFFECT AND RADIOSENSITIZATION PRODUCED BY BASE ANALOGUES INCORPORATED INTO DEOXYRIBONUCLEIC ACID. Henry S. Kaplan, Richard Zavarine, and John Earle (Stanford Univ., Palo Alto, Calif.). Nature, 194: 662-4(May 19, 1962).

A series of experiments was made to study the radiosensitivity produced by base analogues on several thymine- and purine-deficient mutants of Escherichia coli in either O_2 or N_2. The base analogues studied were bromouracil, iodouracil, thioquanine, 6-mercaptopurine, and 2-aminopurine, and thymine and adenine were used as controls. The results show that all the analogues tested made E. coli more radiosensitive in O_2 than the controls but that some analogues did not produce any radiosensitivity in N_2. (D.L.C.)

18783 EVIDENCE FOR A PARTICULAR BASE ALTERATION IN TWO T4 BACTERIOPHAGE MUTANTS. Jane K. Setlow (Oak Ridge National Lab., Tenn.). Nature, 194: 664-6(May 19, 1962).

Reversion of two r_{11} mutants, AP61 and AP156, to the wild-type in the host Escherichia coli by u-v irradiation was studied. The dose relation for reversion is approximately linear for different wavelengths and for irradiation at various times in the latent period. The reversion action spectra are very similar to the thymidine absorption spectrum, which suggests that the two mutants revert to apparent wild-type as a result of an u-v affected thymine in phage DNA. Possible mechanisms are discussed; the most probable one involves a transition between A-T and G-HMC pairs at the mutant site. (D.L.C.)

18784 MUTATION INDUCTION BY PROEMBRYO IRRADIATION. L. W. Mericle and R. P. Mericle (Brookhaven National Lab., Upton, N. Y. and Michigan State Univ., East Lansing). Radiation Botany, 1: 195-202(Apr. 1962).

In mutation breeding programs for many cereal crops, pollen irradiation has not proved to be a practical method for mutation induction, although theoretically the method of choice. The more commonly used procedure, that of irradiating dry seeds containing fully differentiated, mature embryos, has as its principal drawback the small size of the isomutant-carrying sector which can be produced in the R-1 plant. As a consequence of the small R-2 isomutant populations thus available for testing, screening procedures must usually be delayed until the R-3 or later generations. In this study, irradiation of proembryo stages was investigated with regard to the practicality of using this method for mutation induction in cereal crops such as barley. By using albino mutations as genetic sector markers, we find that irradiation of barley proembryos with a relatively low total dose will yield much larger isomutant-carrying sectors and consequently far greater number of isomutant R-2 plants, with a comparable mutation frequency and less sterility than can be obtained by dry seed irradiation. Of great importance to the plant breeder is the possibility that the screening for less drastic mutations and multiple testing can be carried out at least one generation earlier by virtue of the larger isomutant populations produced by proembryo irradiation. Despite the more cumbersome handling involved during radiation treatment, the advantages which proembryo irradiation affords over dry seed irradiation would seem to recommend this method for cereal crops in those situations wherein pollen irradiation is not practical. (auth)

18785 THE EFFECT OF TEMPERATURE ON THE CYTOGENETIC DAMAGE INDUCED BY FAST NEUTRONS IN TRADESCANTIA MICROSPORES. Leo E. LaChance (Brookhaven National Lab., Upton, N. Y.). Radiation Botany, 1: 203-8(Apr. 1962). (BNL-5888)

The effect of temperatures ranging from 0° to 36°C on the induction of chromosome aberrations by 50 rads of fission neutron irradiation has been studied. There was no significant difference between two treatments at 23°C when one was in air and the other in nitrogen, nor between two treatments in nitrogen, one at 23°C and the other at 36°C. However, in nitrogen at 0°C more chromosome exchanges (rings and dicentrics) were found than when radiation was delivered at 23°C. Various mechanisms by which fast neutron irradiation at low temperatures could influence the production of chromosome aberrations under anaerobic conditions are discussed. (auth)

18786 A COMPARISON OF SOMATIC AND POLLEN X-IRRADIATION OF A POLYPLOID, MEDICAGO SATIVA L. Beatrice E. Murray and Iris L. Craig (Canada Dept. of Agriculture, Ottawa). Radiation Botany, 1: 209-14 (Apr. 1962).

The results obtained from a single x-irradiation of pollen of Medicago sativa L. were compared with those from repeated x-irradiation of somatic tissue and considered in relation to the general problem of induced genetic alterations in polyploids. Repeated somatic x-irradiation of clonal lines at 1,500 r and 2,000 r increased the frequency of flower color chimeras, decreased seed set and percentage of viable pollen, but did not induce sufficient variation in inbred or hybrid clones to offset the effects of sterility and inbreeding depression. A reverse mutation was not induced in a trihybrid recessive male sterile line in 66260 branches examined. It is suggested that the population size may be too low to detect a mutation or that the expression may be governed by deficiencies. Pollen x-irradiated at 16000 r gave low seed set, but 41% of the X_1 plants showed visible alterations in flower form, leaf shape, or fertility. Pollen x irradiation was more effective than somatic tissue x irradiation. (auth)

18787 THE EFFECTS OF DEFICIENCIES IN ESSENTIAL ELEMENTS ON THE RADIOSENSITIVITY OF TOMATO SEEDS. H. J. M. Bowen and P. A. Cawse (Wantage Research Labs., Berks, Eng.). Radiation Botany, 1: 215-22(Apr. 1962).

Tomato seeds deficient in most of the elements known to be essential for higher plants were tested for their sensitivity to gamma radiation. In the first generation leaf length was used as an index of radiation sensitivity; zinc deficient seeds were much more radiosensitive than controls, as to a lesser extent were seeds deficient in copper, molybdenum, and sulfur. In the second generation, the spectrum of mutations produced from irradiated deficient seeds was compared with that from irradiated controls. Pale green cotyledon mutants were significantly more frequent from manganese-deficient seeds, and much less frequent from zinc-deficient seeds; a low yield of mutants was found from seeds deficient in magnesium and boron. (auth)

18788 RADIOSENSITIVITY OF HIGHER PLANTS, AND CORRELATIONS WITH CELL WEIGHT AND DNA CONTENT. H. J. M. Bowen (Wantage Research Lab., Berks, Eng.). Radiation Botany, 1: 223-8(Apr. 1962).

Cell fresh weight and DNA per cell were measured in the leaves of forty species of higher plants. These data are compared with the LD_{50} for Co^{60} gamma radiation for dry seeds of the same species. The relation between LD_{50} and cell fresh weight is significant and the relation between LD_{50} and DNA per cell is highly significant. DNA per cell is a major factor determining plant radiosensitivity, but other factors are also important. (auth)

18789 SOMATIC MUTATION RATES IN DOUBLE AND TRIPLE HETEROZYGOTES OF IMPATIENS BALSAMINA FOLLOWING CHRONIC GAMMA IRRADIATION. Ralph E. Alston and Arnold H. Sparrow (Univ. of Texas, Austin and Brookhaven National Lab., Upton, N. Y.). Radiation Botany, 1: 229-32(Apr. 1962). (BNL-5666)

A somatic mutation rate has been determined for petals of Impatiens balsamina heterozygous for flower color. The mutations are thought to result from marker loss of the dominant allele. The mutation rate for the L allele per r of daily exposure determined at 200 r/day was 1 in 0.76×10^6 cells. The dosage-response curve appears to be non-linear at the higher dose rates. (auth)

18790 THE GAMMA RADIATION FIELD OF THE "COMITATO NAZIONALE PER L'ENERGIA NUCLEARE," ROME. F. D'Amato, G. T. Scarascia, U. Belliazzi, A. Bassani, S. Cambi, P. Cevolotto, P. Giacalone, and S. Tagliati (Comitato Nazionale per l'Energia Nucleare, Rome). Radiation Botany, 1: 243-6(Apr. 1962).

A brief account is given of the characteristics and operation of the gamma radiation field. Irradiation work at the gamma field by members of the Laboratory of Plant Genetics and guest-investigators is also described briefly. (auth)

18791 TUMOR FORMATION ON IRRADIATED LEAVES OF A TOBACCO HYBRID. George L. Hagen and James E. Gunckel (Rutgers Univ., New Brunswick, N. J.). Radiation Botany, 1: 247-9(Apr. 1962).

Wounding of leaves of the tobacco hybrid Nicotiana glauca × N. langsdorffi caused tumor formation at the site of the wound where metabolites would have collected under normal transport conditions. Gamma irradiation, which above certain levels enhances tumor formation in this hybrid, changed neither the site nor the amount of tumor tissue formed. Tumor development closely followed the pattern of wound callus formation. (auth)

18792 CONDITIONING IN FISH: EFFECTS OF X-IRRADIATION. Barron B. Scarborough and Robert G. Addison (Florida State Univ., Tallahassee). Science, 136: 712-13(May 25, 1962).

Fish were subjected to different levels of high intensity x irradiation to ascertain the effects of x rays on acquisition and retention of conditioning. Lethal dosages were also determined. Light was the conditioned stimulus, and electric shock the unconditioned stimulus. Responses were forward darting and backward swimming movements accompanied by increased gill movement. Acquisition of conditioned responses was suppressed by higher dose levels. (auth)

18793 RESEARCH ON THE PROBLEM OF TRANSMISSION OF BACTERIAL RESISTANCE FACTORS IN THE RADIATION DAMAGED WHITE MOUSE. Georg Schabinski and Walter Ahlendorf (Universität, Jena, Ger.). Strahlentherapie, 117: 536-45(Apr. 1962). (In German)

The prevention of acute irradiation death of mice at a dose of 1000 r is almost possible by oral administration of pretreated radiation sensitive E. coli strains, which became catalase positive. The 8.2 day mean survival time of the control animals is prolonged to 16.8 days for the treated mice. The reasons for this radiation protection effect are discussed. The effective protection substance is bound to the living bacteria cell and is the catalase-activity of the E. coli strains, which were fed to the mice. (auth)

18794 HEMATOLOGICAL STUDIES ON GUINEA PIGS AFTER INCORPORATION OF RADIONUCLIDES IN HIGH DOSES. REPORT II: PERIPHERAL BLOOD PICTURE CHANGES AFTER INCORPORATION OF Y^{90}, Y^{91}, AND Ce^{144}. Ernst Spode (Institut für Medizin und Biologie der Deutschen Akademie der Wissenschaften, Berlin-Buch). Strahlentherapie, 117: 546-59(Apr. 1962). (In German)

Changes in the peripheral blood picture of guinea pigs, after incorporation of Y^{90}, Y^{91}, and Ce^{144} at a dose of 2.5 $\mu C/g$ body-weight, are reported. The greatest change was produced by Ce^{144}. Tracer free Y^{90} and Y^{91} were slightly less effective. A general increase of the cell counts in the peripheral blood was observed after Y^{90} application of higher specific activity. This is in contrast to the other radioactive substances. (auth)

18795 EFFECTS OF IRRADIATION WITH ULTRAVIOLET LIGHT ON GASTRIC JUICE SECRETION. Hans-Guenter Giessmann and Alfred Fuhlisch (Humboldt-Universität, Berlin). Strahlentherapie, 117: 597-600 (Apr. 1962). (In German)

An increase of H^+-ions and of the gastric-juice secretion after an irradiation of rats with ultraviolet light was demonstrated. The concentration of H^+-ions was increased significantly, after 4 hours, while the increase of the gastric-juice production was proven statistically not to occur earlier than 6 hours after irradiation. (auth)

18796 LIGHT INFLAMMATION AND LIGHT PIGMENTATION. Arthur Wiskemann (Universitäts-Hautklinik, Hamburg-Eppendorf). Strahlentherapie, 117: 608-15(Apr. 1962). (In German)

The measurement, spectral effect curve, gradation, origin, and dependence of inflammation on the dose distribution of UV-light as a function of time are the bases for a discussion of the UV-erythema and pigmentation. The investigations show that an 18-fold increase of the dose rate (so-called flash irradiation) has no influence on the erythema threshold dose, on the radiation tolerance, or on the resultant hyperpigmentation. The type of indirect pigmentation caused by light is discussed and the questionable existence of a direct light pigmentation is confirmed using the experiments and measurements. (auth)

18797 STRAHLUNG UND WETTER. HANDBUCH DER ALLGEMEINEN PATHOLOGIE. ZEHNTER BAND. UMWELT I. ERSTER TEIL. (Radiation and Weather. Handbook of General Pathology. Volume 10. Environment. I. Part 1). H. Fritz-Niggli, G. Miescher, B. de Rudder, F. Schwarz, and H. U. Zollinger. Berlin, Springer-Verlag, 1960. 442p.

The pathological effects of radiation and of weather are considered. In the discussion of radiation pathology, general radiobiology, radiohistology and radiohistopathology, biology and pathology of visible light, ultraviolet, and infrared, and the modifications induced in the human body by the passage of an electrical current are summarized. The discussion of weather pathology considers weather, time of year, and climate as pathogenic factors. (J.S.R.)

18798 OSOBENNOSTI REAKTSII RASTUSHCHEGO ORGANIZMA NA DEISTVIE IONIZIRUYUSHCHEI RADIATSII. (Peculiarities in Reactions of Growing Organisms to the Ionizing Radiation). L. A. Shapiro, T. V. Fokina, T. D. Mirimova, Z. A. Rassadina, T. M. Mel'gunova, and K. A. Moskacheva. Moscow, Medgiz, 1960. 180p.

Pathological effects of ionizing radiation on growing organisms were studied in irradiated animals and children exposed to radiation during radiotherapy. The general health and behavior of the subjects, body weight, skin tissues, blood picture, and life span were analyzed as well as the other aspects of injury such as organs and tissue function. 186 references to Russian publications and 83 foreign references are included. (R.V.J.)

Radiation Sickness

18799 BONE MARROW TREATMENT OF MICE LETHALLY IRRADIATED WITH GAMMA-RAYS UNDER HIGH DOSE RATE. IV. SUPPLEMENTARY STUDIES. Morihisa Yamagishi, Kazushige Adachi, Shigeru Shirakawa, Michiaki Yamaba, and Haruto Uchino (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 42-53(Mar. 1962). (In English)

Mice were irradiated with gamma rays under high dose rate (42 r per second) and then treated with isologous, homologous, and heterologous bone marrow under various experimental conditions. By increasing the dose of isologous bone marrow from 10×10^6 to 20×10^6 nucleated cells, a fairly good survival rate was obtained even when isologous bone marrow (IBM) was injected as late as 6 days after irradiation. Even with this dose IBM injection at 7 days was not effective in obtaining surviving mice. The IBM dose as small as 0.1×10^6 nucleated cells was effective in obtaining fairly good survival rate when IBM was given immediately after irradiation. However, larger IBM dose is desirable because of quicker regeneration of hematopoietic organs in mice receiving a larger dose. The quick recovery of hematopoietic organs in mice lethally gamma irradiated and treated with IBM was proved chemically by the early incorporation of formate-C^{14} into the bone marrow and spleen after irradiation. Iron metabolism in irradiated and IBM treated mice was also studied. The delayed treatment with homologous bone marrow (HBM) from one to four days post-irradiation seemed effective in obtaining a good initial 14 day survival rate. Heterologous rat bone marrow (RBM) has so far been ineffective even by changing experimental conditions variously. When homologous donor mice were given AET followed by 500 r (or 100 r) irradiation, neither initial nor subsequent survival of lethally irradiated recipient was good. When recipient mice were given AET followed by an otherwise supralethal dose of irradiation (1500 r) good initial survival was obtained. Bone marrow dose did not seem to modify radiation damage to tissues other than those of the hematopoietic system as shown by retarded growth and reduced life span. Furthermore, evidences of late radiation effect such as nephrosclerosis and calcification of myocardium were observed in gamma irradiated and IBM treated mice. (auth)

18800 THE ACCUMULATION OF RADIOACTIVE CAESIUM IN CRABS. G. W. Bryan. J. Marine Biol. Assoc. United Kingdom, 41: 551-75(1961).

The accumulation of Cs^{134} and K^{42} from artificial sea water was followed in crabs of several species. In all cases Cs^{134} is taken up far more slowly than K^{42} but at equilibrium a higher concentration factor is attained by Cs^{134}. In Carcinus a value of about 8 is found for Cs^{134} and about 4 for K^{42}. Uptake of Cs^{134} in Carcinus is not affected by feeding on inactive food over a period of 1000 hr. The relationship between the rates of uptake of the 2 isotopes is not the same in the different species, and it is concluded that it would not be possible to predict with any accuracy rates of uptake for Cs^{134} in other species of crabs from the results of short K^{42} experiments. Uptake of Cs^{134} was followed in the blood and tissues of Carcinus and Cancer, and muscle is the principal limiting factor in the attainment of equilibrium by whole animals. Uptake of K^{42} by tissues was also followed, and in all species nearly all the inactive K appears to be readily exchangeable. At equilibrium in all species plasma/sea water and tissue/plasma Cs^{134} ratios nearly always exceed those for inactive K. The tissue/plasma Cs^{134} ratios in Carcinus are about twice those for K and the significance of this is discussed. Loss of both isotopes in whole Carcinus is a slower process than uptake. Isotope accumulation takes place mainly across the body surface in unfed animals, but uptake of Cs^{134} from food is very rapid and complete and would considerably enhance the attainment of equilibrium in a natural environment. Selective excretion of Cs^{134} relative to K was found in Carcinus, Cancer, and Portunus puber. (Public Health Eng. Abstr., 42: No. 3, March 1962)

18801 COMPARISON OF RADIATION PROTECTIVE SUBSTANCES IN THE USE OF ULTRAVIOLET LIGHT AND X RADIATION. Kurt Flemming (Universität, Greifswald, Ger.). Strahlentherapie, 117: 616-23(Apr. 1962). (In German)

Comparable investigations about the effective mechanism of radiation protection substances have been done in vitro using UV- and roentgen hemolysis. Using the experimental results, the problem of whether physical as well as chemical factors are responsible for the protection effect is discussed from the standpoint of general radiation biological views. (auth)

CHEMISTRY

General and Miscellaneous

18802 (UCRL-10032) BIO-ORGANIC CHEMISTRY · QUARTERLY REPORT, SEPTEMBER THROUGH NOVEMBER 1961. (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 25, 1962. Contract W-7405-eng-48. 126p.

Progress in bio-organic chemistry is reported. Topics covered include: molecular orientation in quantasomes, magneto-optic rotary dispersion of spectra, oxidation states of manganese hematoporphyrin IX, nuclear magnetic resonance of methyl esters of inorganic oxyacids, labeling rates in photosynthesis with $C^{14}O_2$, methyl phosphate formation in methanol mixtures with P^{32}-phosphate and sonically ruptured spinach chloroplasts, chemical effects of radiation on cytosine, Ulilzbach tritium labeling, thermal transients in ascites tumor suspensions, effects of deuterium and tritium on drosophila, and variation in environmental complexity and brain measures. Separate abstracts were prepared for two of the topics. (M.C.G.)

18803 (UCRL-10032(p.90-3)) THE CHEMICAL EFFECT OF IONIZING RADIATION ON CYTOSINE. Cyril Ponnamperuma and Richard M. Lemmon (California. Univ., Berkeley. Lawrence Radiation Lab.).

The breakdown of the pyrimidine ring and deamination in the irradiation of cytosine were investigated. Optical density of the cytosine decreased with increasing radiation. The cytosine was found to be less sensitive to radiation than adenine and quanine. The conversion of cytosine to uracil was observed. The maximum yield of uracil was 7.7% at 2×10^6 rads. (M.C.G.)

18804 (UCRL-10032(p.118-19)) FURTHER STUDIES OF THE EFFECTS OF DEUTERIUM AND TRITIUM ON DROSOPHILA. Ann M. Hughes (California. Univ., Berkeley. Lawrence Radiation Lab.).

A statistically significant increase in the number of unusual progeny from D_2O-treated males over control males of Drosophila melanogaster was found consistently. Suggestions that part of the D_2O-effect might be due to the relatively high tritium content of some of the D_2O stock solutions were not substantiated by experiments in which controlled amounts of tritium were added to D_2O. However, tritium alone caused the occurrence of a mutant in two consecutive experiments. (M.C.G.)

18805 NEW SCALE OF NUCLIDIC MASSES AND ATOMIC WEIGHTS. Edward Wichers (National Bureau of Standards, Washington, D. C.). Nature, 194: 621-4 (May 19, 1962).

A discussion is presented of the situation which led to the existence of the chemical scale (atomic weight of element O = 16) and the physical scale (atomic weight of principal O isotope = 16) and of the considerations that led to their replacement by a new scale. In 1959, the International Commission of Atomic Weights recommended the adoption of C^{12} as the reference species with assigned relative mass of 12, since this isotope was acceptable to both chemists and physicists. The International Union of Pure and Applied Physics and the International Union of Pure and Applied Chemistry adopted this recommended scale. A table of atomic weights developed from a complete review of experimental data on the basis of the new scale is presented together with a separate table for radioactive elements. (D.L.C.)

18806 PREVENTION OF UPTAKE OF STRONTIUM IONS ON GLASS. G. Boocock, J. H. Grimes, and S. P. Wilford (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nature, 194: 672(May 19, 1962).

The problem of preventing Sr uptake at neutral pH by container materials is discussed. Sr uptakes after shaking at pH 7 for 24 hr were determined for tubes of glass, polythene, and glass coated with polyester resin. Glass was found to take up 12 ± 8% of the Sr from a 1×10^{-3} M Sr^{2+} solution, while polythene took up 66 ± 6% from the the same solution. Glass coated with polyester resin took up only 0 to 1% from the same solution and was adopted as container material for storage of dilute Sr solutions. It was found that vigorous shaking caused breakdown of the coating after 60 to 70 hr, but the coating life can be extended by coating the glass first with vinyltrichlorosilane and then with polyester resin. (D.L.C.)

18807 FLUORINE CELL ANODE ASSEMBLY. R. E. Cable, W. B. Goode, Jr., W. K. Henderson, and G. H. Montillon (to U. S. Atomic Energy Commission). U. S. Patent 3,041,266. June 26, 1962.

An improved anode assembly is designed for use in electrolytic cells in the production of hydrogen and fluorine from a molten electrolyte. The anode assembly comprises a copper post, a copper hanger supported by the post, a plurality of carbon anode members, and bolt means for clamping half of the anode members to one side of the hanger and for clamping the other half of the anode members to the other side of the hanger. The heads of the clamping bolts are recessed within the anode members and carbon plugs are inserted in the recesses above the bolt heads to protect the bolts against corrosion. A copper washer is provided under the head of each clamping bolt such that the anode members can be tightly clamped to the hanger with a resultant low anode joint resistance. (AEC)

18808 HEAVY METAL LOADED PLASTIC SCINTILLATING COMPOSITIONS. M. Hyman, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,041,287. June 26, 1962.

This invention relates to a plastic scintillation composition having incorporated in the base plastic a lead compound. This compound forms a haze-free scintillator. The lead compound has the general formula $(R_4)_x Pb(OCOCR_1R_2R_3)_{2-x}$, where R_1, R_2, and R_3 are selected from the group consisting of hydrogen, alky, and phenyl, R_4 is selected from the group consisting of acrylyl and methacrylyl radicals, and x is a number from 0.5 to 1; however, when R_1, R_2, and R_3 are all hydrogen the x is equal to 1. The phosphor in the scintillating composition and the lead compound can be dissolved in a polymeric resin selected from the group consisting of polyvinyl toluene and copolymers of vinyl toluene and cyclohexyl methacrylate. (AEC)

Analytical Procedures

Refer also to abstract 19282.

18809 (AERE-AM-89) THE DETERMINATION OF RADIOSILVER. G. J. Hunter, G. F. Marshall, and M. Perkins (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Feb. 1962. 12p.

Radiosilver with added silver carrier was separated from other fission products by a chloride precipitation. After dissolution of the silver chloride in ammonia solution, silver sulfide was precipitated, and further purification was achieved by scavenging with ferric hydroxide, followed by precipitation of the silver as the sulfide and then the iodide, which is counted. The method is applicable to solutions of fission products in nitric or hydrochloric acid. (auth)

18810 (DP-673) PRECISE DETERMINATION OF NEPTUNIUM BY COULOMETRY. Myron O. Fulda (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1962. Contract AT(07-2)-1. 8p.

A coulometric method was evaluated for the precise measurement of neptunium. The precision at 95% confidence limits was 0.6% for aliquots that contained 6 mg of neptunium. The validity of the method was confirmed by measuring the specific activity of neptunium by alpha counting of a pure solution whose concentration had been determined coulometrically. (auth)

18811 (KAPL-M-SLJ-7) POTENTIOMETRIC DETERMINATION OF URANIUM. REDUCTION WITH CHROMOUS SULFATE AND TITRATION WITH CERIC SULFATE. S. L. Jones (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 30, 1961. Contract W-31-109-eng-52. 24p.

Uranium may be determined with high accuracy by reduction with Cr II in H_2SO_4 solution, removal of excess Cr II with an air purge, addition of excess Fe^{3+}, and titration of the equivalent Fe^{3+} with standard $Ce(SO_4)_2$. Titration is carried out on an automatic titrator, using a potentiometric end-point. Zirconium and niobium do not interfere when the proper precautions are observed. Tin appears to interfere slightly. Iron is titrated quantitatively, but may be corrected for by a separate determination. At the 50 mg level of uranium a precision of better than ±0.5% relative is easily obtained. (auth)

18812 (MCW-1445) X-RAY SPECTROGRAPHIC DETERMINATION OF IRON IN URANIUM ORE CONCENTRATES. W. C. Stoecker (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). May 18, 1962. Contract W-14-108-eng-8. 14p.

An x-ray spectrographic method for the determination of Fe in U ore concentrates was developed. Although very simple from a manipulative standpoint, the method has a precision and accuracy superior to the chemical methods heretofore in use. The relative precision for levels of Fe above 1.2% is ±3.0% or better at the 95% confidence level. The normal lower limit for iron is considered to be 0.2%, at which point the relative precision is approximately ±20%. Sensitivity is somewhat limited because of the presence of a heavy (high atomic number) matrix, and the absorption of Fe Kα radiation by air. Although increased sensitivity could be realized through use of a He or vacuum path, the range of the present method is sufficient for almost all samples encountered so far. No elements have been found which interfere at levels normally present in uranium ore concentrates. (auth)

18813 (NYO-10195) ANALYTICAL SEPARATIONS IN THE PRESENCE OF A LARGE PROPORTION OF BISMUTH. Final Report, January 1, 1956–August 31, 1961. Arno H. A. Heyn (Boston Univ.). May 4, 1962. Contract [AT(30-1)-1873]. 8p.

Methods were developed for the analysis of uranium and other elements in the presence of a large excess of bismuth. An ion-exchange method for separation of uranyl ion as the sulfate complex from bismuth was developed. An investigation was made of the separation afforded from plutonium by this same method. An analytical separation procedure was developed for the extraction of uranyl ion by extractants of the tris-alkyl phosphine oxide type. A satisfactory spectrophotometric determination of the uranium could be made in the extracting medium. (M.C.G.)

18814 (ORO-484) GEIGER COUNTING OF TRITIUM AS WATER VAPOR. Final Report. Ralph L. Ely, Jr. and L. F. Ballard (Research Triangle Inst., Durham, N. C. Isotope Development Labs.). July 1, 1961. Contract AT(40-1)-2513. 48p.

Results of an investigation on the use of water vapor plus Q-gas (98.7% helium–1.3% butane) as a Geiger counting mixture are presented. If the counting system is heated to 100°C, water will exist as a gas or vapor at any partial pressure up to a maximum of 760 mm Hg. Q-gas may be introduced to the desired pressure. Both batch counting and flow counting methods were used. Useful plateaus exist at water vapor pressures up to 400 mm Hg with Q-gas added to give a total pressure of 760 mm Hg. The counting efficiency decreases with increased water vapor pressure and is about 70% for water vapor pressures around 400 mm Hg. The operating voltage increases with increased water vapor pressure. Backgrounds are normal. Memory is less than 0.5% for the succeeding sample and can be reduced to 0.02% by flushing several times with water. (P.C.H.)

18815 (PG-Report-225) ANALYTICAL METHOD FOR THE DETERMINATION OF AMMONIA AND NITRATE IN ORES. (United Kingdom Atomic Energy Authority. Production Group. Springfields, Lancs, England). 1962. 8p.

The ore sample is dissolved in sulfuric acid. After neutralization with sodium hydroxide the ammonia is separated by steam distillation into standard hydrochloric acid. The excess acid is titrated with standard alkali using screened methyl red as indicator. Nitrate is then reduced with Devarda's alloy to ammonia, which is steam distilled into standard hydrochloric acid. (P.C.H.)

18816 (PG-Report-255) COLLECTED ANALYTICAL METHODS FOR THE ASSAY AND ANALYSIS OF TRIBUTYL PHOSPHATE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 27p.

The procedures include assay for TBP content, and determination methods for butanol, water, Cl, total acidity, refractive index, specific gravity, and color. (J.R.D.)

18817 (PG-Report-295) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF NICKEL IN MAGNESIUM/MANGANESE ALLOYS. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 5p.

The alloy is dissolved in HNO_3 and the Ni extracted as the dimethylglyoxime complex into chloroform from alkaline solution. The chloroform solution is acid-extracted and the Ni in the extract determined absorptiometrically as the oxidized dimethylglyoxime complex. (auth)

18818 (TID-15415) ANALYTICAL METHODS FOR RADIOSTRONTIUM ESPECIALLY APPLICABLE TO ANALYSIS OF ORGANIC MATERIALS, 1950-1955. A Bibliography. Gretchen R. Riese, comp. (Los Alamos Scientific Lab., N. Mex.). Jan. 21, 1957. Contract [W-7405-Eng-36]. 16p. (D-BIB-3)

Sixty-two references selected from Nuclear Science Abstracts (1948-55) and Chemical Abstracts (1950-55) are included. References are arranged in chronological order. Emphasis is placed on methods applicable to the analysis of water, milk, soil, and biological materials. (C.H.)

18819 (TID-15658) MICROANALYSIS WITH THE GRAPHITE INDICATING ELECTRODE. Report No. 68. Philip J. Elving and David L. Smith (Michigan. Univ., Ann Arbor. Dept. of Chemistry). Mar. 20, 1962. Contract AT(11-1)-1148. 21p.

The utility of the graphite indicating electrode in stationary and rotating electrode voltammetry, chronopotentiometry, and amperometric titration is reviewed on the bases of existing literature and new data. The effects of experimental conditions on the three principal operational criteria of a microanalytical method in terms of performance, sensitivity, precision of quantitative measurement, and selectivity, were determined. By use of a standardized procedure for preparing and conditioning the electrode, results were obtained which compared quite favorably with those obtained with platinum and mercury electrodes. Graphite electrode voltammetry and chronopotentiometry generally yielded results precise to 3% or better over the concentration range of 10^{-2} to 10^{-4} M, corresponding to 1 mg to 0.1 μg per ml of a substance with a formula weight of 100. The principal advantage of the graphite electrode is the ease with which anodic electrode processes, especially the oxidation of organic compounds, can be observed up to potentials of 1.2 v vs SCE or more positive. (auth)

18820 SQUARE-WAVE POLAROGRAPHY WITH SPECIAL REFERENCE TO THE ANALYSIS OF ZIRCONIUM AND HAFNIUM. D. F. Wood and R. T. Clark (Imperial Metal Industries (Kynoch) Ltd., Birmingham, Eng.). Analyst, 87: 342-8(May 1962).

Experiments to assess the application of a Mervyn-Harwell square-wave polarograph, particularly to the direct determination of impurities and alloying constituents in zirconium, are described. The tests showed that Cu, Pb, Mo, W, and Zn can be determined in certain zirconium-based materials by direct polarographic methods; copper can be determined simultaneously with molybdenum. A direct polarographic determination of any one of these metals (or two when simultaneous determinations are possible) takes about 45 minutes, whereas determinations by alternative chemical procedures take much longer. Tests also showed that Cu, W, and Cd can be determined in hafnium after simple solution of the sample. (auth)

18821 THE DETERMINATION OF ZINC BY NEUTRON ACTIVATION. T. B. Pierce and P. F. Peck (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Analyst, 87: 369-73(May 1962).

Several samples, widely different in composition, were analyzed for zinc by neutron activation. The method devised for separating zinc in a radiochemically pure form included the use of a column of dithizone retained with an organic solvent on cellulose acetate; this separation was completed sufficiently rapidly to permit convenient measurement of the activity of the 52-minute Zn^{69} nuclide if an increase in sensitivity over that provided by measuring the activity of the 13.8-hour Zn^{69m} nuclide was required. (auth)

18822 GASOMETRIC AND GRAVIMETRIC METHODS FOR DETERMINING THE OXYGEN CONTENT OF SODIUM AND THEIR APPLICATION FOR THE ANALYSIS OF THE OXIDE CONTENT OF TRAPS. F. A. Kozlov. Atomnaya Energ., 12: 332-3(Apr. 1962). (In Russian)

Determination of the exact oxide content is very important for the proper maintenance of cold traps used to remove the oxide content of Na. Gasometric and gravimetric methods of analysis showed great promise although they present the disadvantage that the accuracy of the data depends on the absolute value of the O content, being low at low concentrations. The gasometric analysis is based on the formation of H_2 gas during the reaction of Na and water or ethyl alcohol, while the gravimetric method takes advantage of the more than twofold difference between the specific weights of Na and its oxide; the measurements were carried out by weighing during immersion in kerosene. As the O content of the samples taken from the cold traps reached several percent, the metallic Na surface in contact with air was small and there was no need to protect the surface of the metal. The error due to the presence of other elements does not exceed 0.1%. (TTT)

18823 RADIOACTIVATION ANALYSIS. APPLICATION TO THE DETERMINATION OF IODINE, MERCURY, COPPER, MANGANESE, AND ZINC IN BIOLOGICAL MATERIALS. Dominique Comar, Claude Le Poec, Monique Joly, and Claude Kellershohn (Commissariat à l'Énergie Atomique and Service Hospitalier Frédéric Joliot, [Saclay], France). Bull. soc. chim. France, No. 1, 56-71(Jan. 1962). (In French)

After a discussion of the principles of radioactivation, the possibility of applying this technique to the determination of certain oligoelements in biological materials was studied. Blood iodine was determined with a precision of 5%, and the final sensitivity of the method is of the order of 10^{-10} g. The plasmic and blood cell mercury was also determined in 14 normal subjects. The values found were $3.1 \pm 1.7 \times 10^{-3}$ μg/g of plasma, $7.7 \pm 4.1 \times 10^{-3}$ μg/g of blood cells, and $5.2 \pm 2.2 \times 10^{-3}$ μg/g of total blood. Finally a technique for the simultaneous measurement of plasmic copper and manganese is described. The possibility for the simultaneous determination of zinc, copper, and manganese in biological liquids is discussed. (tr-auth)

18824 RADIOMETRIC DETERMINATION OF URANIUM. J. L. Horwood (Dept. of Mines and Technical Surveys, Can.). Can. Nuclear Technol., No. 4, 39-41(1962).

The relatively pure uranium used in alloying is only weakly radioactive; nevertheless, with suitable equipment and techniques capable of measuring the low-energy radiation from the uranium and of its immediate short-lived decay products, sufficient sensitivity can be obtained to determine the uranium content of the steel or alloy. Counting may be done using either of two methods: by recording the rate at which beta particles are given off from the surface of a sample or by measuring the soft gamma radiation emitted from the whole of a thin sample. The methods are described. The radiometric method is faster than using chemical means and just as accurate. (N.W.R.)

18825 ACTIVATION ANALYSIS. J. Van Eesteren. Chemie & Techniek, 17: 61-5(1962).

A review is presented with some remarks concerning the origin of activation analysis. The theoretical principles, technical procedures, and some applications are discussed in a simple way. Finally it is demonstrated that the activation analysis has a good future. (auth)

18826 DETERMINATION OF BORON TRACES BY MASS SPECTROMETRIC ISOTOPIC DILUTION. Michèle Perie and Marius Chemla (Collège de France, Paris). Compt. rend., 254: 1429-31(Feb. 19, 1962). (In French)

Traces of boron contained in some acids and reagents, as well as in some soft steels, were determined by isotopic dilution with B^{10}. The boron is extracted in the form of methyl borate, saponified, and analyzed in the form of borax. Concentrations of 150 to 0.0005 μg were measured with a precision of 10 to 20%. (tr-auth)

18827 THE DETERMINATION OF ALUMINUM, VANADIUM, MAGNESIUM, AND TITANIUM IN METALS BY

NEUTRON IRRADIATION. Louis Fournet, Norbert Deschamps, and Philippe Albert (Centre National de la Recherche Scientifique, [Paris]). Compt. rend., 254: 1640-2 (Feb. 26, 1962). (In French)

A general method for the determination of aluminum, vanadium, magnesium, and titanium by their short-lived radioisotopes produced by the (n,γ) reaction is presented. Traces of the element to be determined are separated, before irradiation, on a nonisotopic carrier. (tr-auth)

18828 SEPARATION AND DETERMINATION OF SMALL CONCENTRATIONS OF STRONTIUM OR OF STRONTIUM AND BARIUM TOGETHER IN CALCIUM. V. Novák and A. Tockstein (Technische Hochschule für Chemie, Pardubice, Czechoslovakia). Collection Czechoslov. Chem. Communs., 27: 41-5(Jan. 1962). (In German)

A method is described for the quantitative separation of low Sr concentrations (up to 1 mg) as the sulfate from calcium. The method depends on the removal of the alkaline earth metals from their complexes with ethylenediaminetetraacetic acid with the use of cobalt ions. On the same principle, a method for the quantitative mutual separation of Sr and Ba (up to 1 mg) from Ca was perfected. In both cases the isolated sulfates were determined polarographically. (tr-auth)

18829 SPECTROPHOTOMETRIC INVESTIGATION OF THE REACTIONS OF THORIUM(IV) AND URANIUM(IV) IONS WITH XYLENOL ORANGE. B. Buděsínský (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Collection Czechoslov. Chem. Communs., 27: 226-31(Jan. 1962). (In German)

The color complexes of uranium(IV) and thorium(IV) ions with xylenol orange were investigated spectrophotometrically. The compositions were determined, and the association and stability constants were calculated. The possibility for the spectrophotometric determination of uranium and thorium on the basis of their reactions with xylenol orange is discussed. (tr-auth)

18830 URANIUM CONTENT OF URANYL NITRATE SOLUTIONS BY SPECIFIC GRAVITY MEASUREMENT AT AMBIENT TEMPERATURE. D. J. Loudin (National Lead Co. of Ohio, Cincinnati). J. Chem. Eng. Data, 7: 266-8 (Apr. 1962).

An expression was derived and a nomograph was produced for obtaining the uranium concentration of a uranyl nitrate solution directly from a specific gravity reading made at temperatures of 10 to 50°C. The free acid content (normality) of the uranyl nitrate solution must also be known before the nomograph can be used. Data are presented of experimental determinations in order to compare the results obtained from the nomograph and the equations derived. (N.W.R.)

18831 DETERMINATION OF RARE EARTHS IN GRAPHITE BY MEANS OF ACTIVATION ANALYSIS. W. Gebauhr and J. Martin (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 4: 9-18(Feb. 1962). (In German)

The utilization of graphite in nuclear technology requires that this material be poor in neutron absorbing impurities. Therefore analytical control, especially for rare earths, is a necessity. A method, based on activation analysis, is described, and with this method all rare earths can be determined one after the other after their separation by ion exchange. The neptunium activity occurring as a characteristic fraction makes possible the determination of the uranium concentration and, consequently, the elimination of this source of error. The usual interferences were also considered. The results obtained on a large number of samples indicate that the behavior of the individual rare earths varies widely from each other in the various samples. It therefore appears inadvisable, because of the high demands on accuracy, to base the determination of an individual rare earth in the usual lanthanide mixture on the general geochemical frequency. (tr-auth)

18832 THE QUANTITATIVE DETECTION OF RADIONUCLIDES, WHICH EMIT γ QUANTA IN CASCADE, WITH A SIMPLE $\gamma-\gamma$ COINCIDENCE ARRANGEMENT (THE INTERFERENCE FREE ACTIVATION ANALYSIS OF HAFNIUM TRACES IN ZIRCONIUM). R. Hecker and W. Herr (Kernforschungsanlage, Julich, Ger.). Nukleonik, 4: 19-23(Feb. 1962). (In German)

A simple spectrometer arrangement is described with which radioisotopes emitting cascade gamma rays can be quantitatively determined on the basis of $\gamma-\gamma$ coincidences in the presence of other gamma emitters. As an example, the hafnium concentration in zirconium was measured. With the relatively poor resolution of the coincidence stage of about 0.4 μsec, which can be attained easily, up to 5 ppm Hf can be detected in nuclear-pure Zr. Because of the high selectivity of the Hf^{181} detection, chemical separations were only necessary when, in addition to the radioisotope to be determined, other radioisotopes emitting γ quanta of corresponding energy were formed in the activation. In the Zr and Zircaloy samples examined in the present study, such interferences were not observed. (tr-auth)

18833 QUANTITATIVE DETERMINATION OF SMALL POLONIUM AMOUNTS. COMMUNICATION II. SUBLIMATION IN VACUUM. L. I. Abramova and D. M. Ziv. Radiokhim. Analiz Produktov Deleniya, Akad. Nauk S.S.S.R., Radievyi Inst., Sbornik Statei, 104-7(1960).

A method for the quantitative separation of Po from powders of rock and artificial mixtures based on sublimation in vacuo was developed. The sublimation is conducted in a quartz apparatus consisting of a small ball with ground-in neck, into which pulverized rock is poured and of a platinum disk 15 mm in dia., which is placed on the ground section and pressed on by means of a brass cylinder which simultaneously serves as water cooler for the disk. The whole system is pumped out during the experiment by an initial vacuum pump. The ball of the apparatus is placed in an electric furnace. At a temperature of 700 to 800°C and a vacuum of 10^{-2} to 10^{-3} mm Hg, the Po is sublimated during 3 hr and quantitatively precipitated on the platinum disk. The method was used for determining Po in magnetite of known uranium content. Results agreed with the theoretical value within the limits of experimental errors. The dependence of Po sublimation on the time of aging of the preparation on platinum was also determined. It was found that after 48 hr aging, a heating of 700°C for 2.5 to 3 hr is required for the Po sublimation. (OTS)

18834 SEPARATION OF HAFNIUM AND ZIRCONIUM. Tech Eng. News, 43: 40(Jan. 1962).

Separation technique uses a strong quaternary-amine anion-exchange resin with diluted H_2SO_4 as eluting solution. Hf and Zr are precipitated in separate fractions and ignited to oxides. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

18835 SEPARATION OF IMPURITIES IN NICKEL, COBALT, IRON, AND CHROMIUM-BASED REFRACTORY ALLOYS. Z. S. Mukhina, I. A. Zhemchuzhnaya, and G. S. Kotova. Zhur. Anal. Khim., 17: 170-3(Mar.-Apr. 1962). (In Russian)

Thionalide was used for separating copper, tin, antimony, bismuth, and arsenic impurities in the analysis of refractory alloys. The method enables more than 0.0001% of each of the elements to be separated. Thionalide also gives sat-

isfactory results in the separation of impurities in pure metals, aluminum, beryllium, magnesium, manganese, zinc, iron, and others. (auth)

18836 SPECTROGRAPHIC DETERMINATION OF INDIUM, THALLIUM, AND TELLURIUM IN SOLUTIONS WHEN THEY ARE EXTRACTED FROM THE INTERMEDIATE PRODUCTS OF THE LEAD–ZINC INDUSTRY. I. G. Yudelevich and I. R. Shelpakova (All-Union Scientific Research Inst. of Non-Ferrous Metals, USSR). Zhur. Anal. Khim., 17: 174-9(Mar.-Apr. 1962). (In Russian)

Processes of feeding solutions into the discharge with the use of a spayer and by saturation of carbon electrodes were studied. Spectrographic methods were developed for the determination of 0.0005–20 g/l of indium, 0.005–1 g/l of thallium, and 0.1–40 g/l of tellurium and arsenic in technological solutions of the rare metal industry. The average arithmetical error of a determination is not more than ±10% (relative). (auth)

18837 DIRECT COMPLEXOMETRIC TITRATION OF GALLIUM IN THE PRESENCE OF 7-(1-NAPHTHYLAZO)-8-HYDROXYQUINOLINE-5-SULPHONIC ACID AS AN INDICATOR. A. I. Busev, L. L. Talipova, and L. M. Skrebkova (Moscow State Univ.). Zhur. Anal. Khim., 17: 180-5(Mar.-Apr. 1962). (In Russian)

The interaction of gallium ions with 7-(1-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid was studied. It was found that gallium reacts with 7-(1-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid in a molar ratio 1:1, the molar extinction coefficient of the compound formed is 1.56×10^4, and the equilibrium constant of the reaction studied is 0.96×10^2. It is shown that 7-(1-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid may be used as indicator in the direct titration of gallium ions with complexone III at pH 2.2 and higher. Calcium, magnesium, manganese, cadmium, and zinc ions do not interfere with the complexometric determination of gallium, as well as aluminum ions in the presence of fluorine ions. A method for the synthesis of 7-(1-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid is specified. (auth)

18838 STUDY OF CERTAIN PHYSICOCHEMICAL CHARACTERISTICS OF INDIUM AND GALLIUM COMPOUNDS WITH FLAVONES. E. P. Shkrobot (State Scientific Research Inst. of Non-Ferrous Metals, Moscow). Zhur. Anal. Khim., 17: 186-9(Mar.-Apr. 1962). (In Russian)

Instability constants and molar extinction coefficients were calculated for indium and gallium compounds with morin, quercetin, and rutin. All the gallium compounds were more stable in comparison with the similar indium compounds. The calculation of instability constants proves that only one complex compound of indium or gallium is formed with each of the flavones. (auth)

18839 QUANTITATIVE SPECTROGRAPHIC DETERMINATION OF SMALL AMOUNTS OF GERMANIUM, INDIUM AND THALLIUM IN SILICATE ROCKS. L. I. Pavlenko and Z. M. Davydova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zhur. Anal. Khim., 17: 199-201(Mar.-Apr. 1962). (In Russian)

A method for the quantitative spectrographic determination of In and Tl in silicate rocks (granite, syenite) was developed. The sensitivity of the determination of In is 1×10^{-4}%, and of Tl is 2×10^{-4}% when a spectrograph of a mean degree of dispersion is used. An average square error for In is ±16%, and for Tl is ±13%. When sodium chloride is used as a buffer, the chemical composition of rocks does not influence the determination. A quantitative method for the determination of Ge in silicates is also proposed. The sensitivity of the determination when samples are sulfidized is 5×10^{-5}%; an average square error is ±15%. (auth)

18840 SEPARATION OF RARE EARTHS FROM MATERIALS CONTAINING IRON, CALCIUM, AND PHOSPHATES. F. V. Zaikovskii, E. V. Furtova, and G. F. Sadova (All-Union Inst. of Mineral Raw Materials, Moscow). Zhur. Anal. Khim., 17: 202-5(Mar.-Apr. 1962). (In Russian)

Conditions for the quantitative precipitation of small amounts of rare earths with acetone dioxalic acid in the presence of iron complexonate were studied. A new precipitator, salicylfluorone, is proposed for the separation of rare earths at pH 5.5–7 from any amount of calcium which remains in solution. A method is also suggested for the separation of small amounts of rare earths from ores containing large amounts of iron, calcium, and phosphorus. One chemist can carry out 10 determinations in 3–4 working days. (auth)

18841 PHOTOMETRIC DETERMINATION OF TITANIUM IN NICKEL- AND IRON-BASED REFRACTORY ALLOYS WITH THE USE OF DIANTIPYRINYLMETHANE. L. Ya. Polyak. Zhur. Anal. Khim., 17: 206-11(Mar.-Apr. 1962). (In Russian)

Spectral characteristics of the titanium-diantipyrinylmethane complex were studied. The influence of all major constituents of light, non-ferrous, and ferrous alloys (molybdenum, tungsten, niobium, tantalum, vanadium, cobalt, iron, nickel, chromium, aluminum, magnesium, manganese, zinc, copper, zirconium, cerium, and rare earths) was investigated. It is shown that diantipyrinylmethane is a highly sensitive and selective reagent for titanium. A photometric method was developed for the determination of titanium in the presence of vanadium in nickel- and iron-based refractory alloys by means of diantipyrinylmethane. The method is applied for the determination of both small (hundredth and thousandth parts of 1%) and large quantities (from 1% and more) of titanium in alloys. (auth)

18842 SUCCESSIVE SPECTROPHOTOMETRIC TITRATION OF THORIUM AND THE SUM OF RARE EARTHS. V. M. Peshkova, M. I. Gromova, and N. M. Aleksandrova (Moscow State Univ.). Zhur. Anal. Khim., 17: 218-21(Mar.-Apr. 1962). (In Russian)

Methods were developed for the spectrophotometric titration with complexone III in the presence of arsenazo I of gamma quantities of the following elements: rare earths (in the presence of ascorbic acid at pH 6.6); thorium (pH about 2); and thorium and the rare earths (by successive titration in a single sample). The method proposed for the determination of thorium and the rare earths, without their preliminary separation, has certain advantages over the method of visual titration (the minimum limit of the determined quantities of these elements is 3–4 orders lower), and over the method of the simple spectrophotometric determination. (auth)

18843 GRAVIMETRIC DETERMINATION OF URANIUM BY ITS PRECIPITATION WITH HEXAMMINE COBALTINITRATE. A. V. Vinogradov and R. M. Apirina. Zhur. Anal. Khim., 17: 222-6(Mar.-Apr. 1962). (In Russian)

A method for the precipitation of uranium with hexamine cobaltinitrate was used for the determination of 1–90% of uranium in its ores and intermediate products, and also in its alloys with various metals. The method is applicable in the presence of all the usual accompanying elements, including vanadium, molybdenum, and tungsten. It is especially suitable for the determination of uranium in uranium tetrafluoride as there is no necessity to remove fluorine. The method was satisfactorily used for the analysis of uranium alloys with aluminum, zirconium, and molybdenum. The main advantages of the method are its simplicity and rapidity. (auth)

18844 SPECTROMETRIC DETERMINATION OF TRI-N-BUTYL PHOSPHATE (TBP) AND DIISOAMYL ETHER OF METHYL-PHOSPHONIC ACID (DEMA) IN SOLVENTS OF SATURATED HYDROCARBON TYPE AND IN KEROSENE. Yu. A. Pentin, E. G. Teterin, and N. N. Shesterikov. Zhur. Anal. Khim., 17: 239-44(Mar.-Apr. 1962). (In Russian)

Spectrometric methods, based on the measurement of optical density at the maximum of the TBP and DEMA infrared absorption bands, were developed for determining TBP in n-hexane, n-octane, n-decane, n-dodecane, n-tridecane, kerosene, and DEMA in kerosene. The methods permit rapid determination of TBP with high accuracy in the concentration limits 0.01–10.0% by the absorption band at 1025 cm^{-1}, and in the limits 5.0–25.0% by the bands at 870 cm^{-1} and 835 cm^{-1}. DEMA can be determined in the concentration range of 0.6–5.0% by the band at 1005 cm^{-1}. The methods are also applicable for the analysis of solutions containing water and acids as impurities. (auth)

18845 CHROMATOGRAPHIC SEPARATION OF SMALL QUANTITIES OF URANIUM FROM SOIL USING ANION-EXCHANGE RESIN. V. D. Zagrai and V. A. Vlasov. Zhur. Anal. Khim., 17: 254-5(Mar.-Apr. 1962). (In Russian)

A method is described for the separation of 10^{-3}–10^{-4} g of uranium from soil samples containing about 300 mg of R_2O_3 by anion exchange using sulfate and uranium chloride complexes. The extinguishing impurities do not interfere with uranium determination by the luminescence method. (auth)

18846 DETERMINATION OF pH IN INITIAL DISSOLVING AND ACTIVITY PRODUCT IN GADOLINIUM HYDROXIDE. P. N. Kovalenko and K. N. Bagdasarov (Rostov-on-Don State Univ., USSR). Zhur. Neorg. Khim., 7: 739-42 (Apr. 1962). (In Russian)

Conditions for colorimetric determination of Gd by alizarin S were found for Gd^{3+}: aliz S = 1 : 1. The pH for initial dissolution of gadolinium hydroxide was determined and the activity product calculated. Studies of KNO_3 effects on the pH of initial dissolution showed that an increase of KNO_3 shifts the pH toward the alkali side. (R.V.J.)

18847 EEN NIET-DISPERGERENDE INFRAROODANALYSATOR EN ZIJN BRUIKBAARHEID VOOR DE ANALYSE VAN MENGSELS VAN WATER EN ZWAAR WATER. (A Non-Dispersive Infrared Analyzer and Its Usefulness for the Analysis of Mixtures of Water and Heavy Water). G. C. A. Bosselaar. Thesis, Utrecht, Rijksuniversiteit, 1961. 134p.

A method of measuring the D/H isotope in mixtures of water and heavy water is developed using a non-dispersive infrared analyzer. In the analyzer, the radiation from an infrared source is partly absorbed by the gas mixture to be investigated. In the range of wavelengths to which the detector is responsive, the absorption is a function of the mixing ratio. Thus after calibration, the apparatus is suited for absolute measurements of the mixing ratio. The analyzer is a double-beam instrument with periodically chopped beams. The alternating voltage from the radiation detector is registered after synchronous rectification. (auth)

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Refer also to abstracts 19274 and 19275.

18848 (AAEC/TM-137) PRELIMINARY EXPERIMENTS ON THE DISSOLUTION OF BERYLLIUM BASED FUELS IN AMMONIUM FLUORIDE SOLUTIONS. H. J. Whitfield (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). May 1962. 9p.

Preliminary measurements were made of the beryllium dissolution rate when refluxed with ammonium fluoride solution. The rate of dissolution exhibits pseudo first order dependence on the free fluoride concentration defined as the concentration of total fluoride less that assumed to be present as BeF_4^{2-}. The solubility of uranium metal in ammonium fluoride–beryllium fluoride solutions increases with free fluoride concentration, where the uranium is present in solutions as U(IV). Thorium metal is attacked only slightly under similar conditions. Beryllium may be selectively leached from UBe_{13} by ammonium fluoride solutions if the final F^-/Be mole ratio is greater than 4 : 1. The solubility of uranium under these conditions suggests that this is not a satisfactory solvent for mixtures of these alloys with Be when the U/Be ratio is small, but that it could be used successfully as a decladding agent for an oxide fuel clad in beryllium metal. (auth)

18849 (CLM-R-16) A MASS SPECTROMETRIC STUDY OF THE OUTGASSING OF SOME ELASTOMERS AND PLASTICS. R. S. Barton and R. P. Govier (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Mar. 1962. 27p.

An account is given of the composition of the residual gas in a vacuum system resulting from the presence of Viton A, a polyurethane rubber, an epoxy resin, polythene and polytetrafluorethylene and presents the mass spectra from which the conclusions were drawn. (auth)

18850 (EURAEC-245) GROWTH OF UO_2 SINGLE CRYSTALS. Quarterly Report No. 2, October 1 through December 31, 1961. (Brussels. Centre d'Étude de l'Énergie Nucléaire). Work performed under United States–Euratom Joint Research and Development Program. Contract 055-61-9RDB. 9p.

Investigations were made on two main problems concerning UO_2 single crystal preparation by sublimation: improvement of the furnace arrangement in order to avoid tantalum contamination of the crystals, and preparation of single crystals doped with Nb_2O_5 and Al_2O_3. Several runs were made to determine the optimum conditions for UO_2 crystal growth from a molten salt solution of uranyl chloride. Polishing experiments of the cathode surface were also performed to study the influence on the nucleation. UO_2 crystals were also grown from the vapor phase. (auth)

18851 (NASA-TN-D-1198) EXPERIMENTAL INVESTIGATION OF LITHIUM HYDRIDE AS A HEAT-SINK MATERIAL. C. Robert Morse and Robert O. Hickel (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1962. 22p.

In addition to determining the potential effectiveness of LiH as a heat-sink material at a temperature of 1880°F, the cooling characteristics of dissociating LiH were determined in containers charged with 15 g of LiH powder and electrically resistance heated to 2200°F. One type of container was 1½ in. square and 3 in. high; the other type was a tube with a diameter of ½ in. and a length of 10 in. Wall temperatures of the containers were obtained as a function of heating time to evaluate the cooling performance. The heat fluxes for the experiments ranged from 10 to 40 Btu/(sec) (sq ft). (auth)

18852 (PAN-266/IV) CONTRIBUTION À L'ÉTUDE DE LA COPRÉCIPITATION DU RADIUM. (Contribution to the Study of Coprecipitation of Radium). Tadeusz Adamski

and Roza Przytycka (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Aug. 1961. 6p.

The coprecipitation of radium chromate with barium chromate was studied using the Adamski method, even to the obtention of microcrystals in which the radium is concentrated along the axis of the crystal. The radon released forms two distinct gas bubbles in the interior which finally break the crystal. (tr-auth)

18853 (TID-15416) ELECTRODE POTENTIAL OF ZERO CHARGE (ABSOLUTE ELECTRODE POTENTIAL. A Bibliography. Lois Godfrey, comp. (Los Alamos Scientific Lab., N. Mex.). June 1957. Contract [W-7405-Eng-36]. 10p. (D-BIB-5)

A bibliography is presented on electrode potential of zero charge. The 49 references are arranged alphabetically by the author. (M.C.G.)

18854 (TID-15700) AN INFRARED STUDY OF HALIDE WINDOW BANDS (thesis). Johnny Hall Dunlap (Vanderbilt Univ., Nashville). June 1956. 42p.

The study of window band formation on NaCl windows by gaseous ClF_3, HF, and F_2 was carried out by recording the infrared absorption pattern of the NaCl windows following each exposure of the windows to the gas at a known pressure for a known period of time. The bands appeared in the region from 2 to 15 μ. It was found that a compound containing the HF_2^+ ion (probably $NaHF_2$) was formed. The infrared absorption of this compound showed peaks at 4.7, 6.25, and 8.25 μ. The formation of $NaHF_2$ on the windows was made possible by the presence of hydrogen either in HF as an impurity or in water vapor. The rate of formation of the compound formed on NaCl windows in the presence of HCl, ClF_3, and F_2 was found to be dependent on the gas and its state of purity, the pressure of the gas, the window itself, and the exposure history of the window. (M.C.G.)

18855 (TID-15707) AN ANALYSIS OF THE INFRARED SPECTRA OF CF_3COCl AND CF_3COBr (thesis). Robert James Lovell (Vanderbilt Univ., Nashville). 1953. 62p.

Infrared spectra studies were made to correlate the experimentally determined infrared bands with the fundamental, overtone, and combinational frequencies of the molecules, CF_3COCl and CF_3COBr. Tables are presented of the positions of the bands, their intensities, and assignments. Theoretical considerations involving the composition and structure of the molecules and analogies with other molecules used to justify and extend the preliminary assignments are discussed. Of the 15 fundamental modes for vibration theoretically predicted, it was possible to assign 5 for both CF_3COCl and CF_3COBr with reasonable certainty. Two more were plausibly assigned for the CF_3COCl and 4 more were plausibly assigned for CF_3COBr. Assignments for the unobserved bending, rocking, and torsional bands below 400 cm^{-1} were postulated. Eight out of 14 overtone and combinational bands were assigned for CF_3COCl and 18 out of 28 were assigned for CF_3COBr. (M.C.G.)

18856 (UCRL-10062) INFRARED ABSORPTION SPECTRA OF METAL–AMMONIA SOLUTIONS (thesis). Marvin Gold (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1962. Contract W-7405-Eng-48. 67p.

Infrared absorption spectra of liquid ammonia solutions of Li, Na, K, Cs, and Ca were studied from 6000 to 25000 Å in the concentration range 0.005 to 0.2 M. Up to 0.03 M Beer's Law is very nearly obeyed for the alkali metals at all wavelengths. Above 0.03 M positive deviations occur at the long-wavelength tail of the band. Similar behavior of the various alkali metals and the relatively constant extinction coefficients indicate that the electron-in-a-cavity, which is responsible for the absorption in very dilute solutions, remains intact as the concentration is increased. It is proposed that the associated species present in moderately concentrated solutions are ion pairs in which the electron cavity is not seriously distorted by the metal ion, and quadrupoles consisting of an assembly of two ion pairs in which the electron spins are paired. It is shown that this model is consistent with many of the physical properties of alkali metal–ammonia solutions and, in particular, resolves the apparent contradiction between the magnetic and spectra data. (auth)

18857 (AEC-tr-5106) THERMODYNAMIC PROPERTIES OF BINARY MIXTURES OF MOLTEN SALTS. DETERMINATION OF THE THERMODYNAMIC ACTIVITY FROM THE ELECTROMOTIVE FORCE OF CONCENTRATION CELLS. I. G. Murgulescu and D. I. Marchidan. Translated by Allen L. Bowman (Los Alamos Scientific Lab., N. Mex.) from Acad. rep. populare Romîne, Studii cercetări chim., 7: 461-73(1959). 15p.

Results obtained by applying to the determination of the activities of binary systems of fused salts measurements of the emf of concentration cells of the form $Me_1 | Me_1X_{N1}(1) || Me_1X_{N1}(1,N_1) + Me_2X_{N2}(1,N_2) | Me_1$ are presented. Me_1 is a heavy metal, Me_2 is an alkali metal, and X_2 represents a halogen. It is shown that from the emf of the concentration cell, values of the activity of the pure salt Me_1X_{N1} in the binary mixture $Me_1X_{N1} + Me_2X_{N2}$ can be obtained if the diffusion potential can be evaluated. It was found that, at the liquid junction of a concentration cell with fused salt, the diffusion potential has a value of practically zero. The values of thermodynamic activities and activity coefficients agreed satisfactorily with those deduced from the emf's of the formation cells. (M.C.G.)

18858 (ORNL-TM-231) PREPARATION AND PROPERTIES OF HIGH CONCENTRATION SOLS. PART IV. THORIUM HYDROXIDE SOLS. N. R. Dhar and R. M. Mittra. Translated by C. E. Schilling (Oak Ridge National Lab., Tenn.) from Kolloid-Z., 71: No. 2, 172-6(1935). 13p.

The preparation and properties of high-concentration thorium hydroxide sols are described. Freshly precipitated $Th(OH)_4$ was peptized with small quantities of $Th(NO_3)_4$. The resulting sol was concentrated by heating directly over a flame. The sol was purified by hot dialysis. When impure $Th(OH)_4$ contained a large fraction of $Th(NO_3)_4$, it became more stable to coagulation by monovalent ions on dilution. The coagulation of both pure and impure sols showed an additive effect if coagulated by a mixture of $KBrO_3$ and K_2SO_4. The lower the purity, and more stable the sol, the lower the viscosity. Concentrated $Th(OH)_4$ sols became more viscous with age. If the sols were diluted, the viscosity decreased with aging. The electrical conductivity of the sols increased with aging. (M.C.G.)

18859 (UCRL-Trans-795(L)) INFRARED PROPER VIBRATIONS OF BINARY OXIDES, BeO, MgO, CaO, ZnO. Sibylle Tolksdorf. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Z. physik. Chem. (Leipzig), 132A: 161-84(1928). 26p.

The oxides BeO, MgO, CaO, and ZnO were investigated in absorption to infrared natural oscillations in the region from 2 to 22μ. Some reflection measurements on pressed powders showed only the basic oscillations on account of the weak reflection capacity. A method of absorption measurements on thin powder coatings, which were enclosed between rock salt plates, was worked out. The transmission spectrum was studied for BeO, MgO, CaO, and ZnO. More-

over, the spectrum was determined for thin zapon films. With all the oxides deviations resulted from the assumptions of the Born-Brester systematics, where only one or two frequencies should appear. The lattice in question oscillates anharmonically throughout. The regular crystals MgO and CaO, according to their simple lattice types, show simple spectra. For MgO the basic frequency ν (14.2μ) and the overtones to 2ν and for 4ν were found, for CaO the basic frequency ν was at 22.05μ. Also, for CaO an overtone 2ν was determined. The overtone 3ν was missing with MgO and CaO. The crystals BeO and ZnO possess a complicated structure of the natural oscillation spectrum, according to their non-regular build (hexagonal, wurtzit type). The classification of both spectra according to overtones and combinations requires the assumption of three active basic oscillations (ν_1, ν_2, and ν_3). The overtones $2\nu_1$ and $2\nu_2$ appear explicitly, however, $3\nu_1$ and $4\nu_1$ or $3\nu_2$ and $4\nu_2$ only in combination. The $\beta\nu$-values taken from the optically determined natural frequencies stand in satisfactory agreement with the values of $\beta\nu$ calculated from melting point, compressibility, and specific heats. (auth)

18860 HIGH-TEMPERATURE ELECTROCHEMICAL STUDY OF URANIUM OXIDES IN THE $UO_2-U_3O_8$ REGION. Kalevi Kiukkola (Inst. of Tech., Otaniemi, Finland). Acta Chem. Scand., 16: 327-45(1962). (In English)

Electromotive force measurements on galvanic cells involving solid electrolytes were made at temperatures of 800 to 1200°C in order to obtain standard thermodynamic data for the mixing of UO_2 and oxygen gas. Due to purely anionic conductivity of the electrolyte, a direct evaluation of the relative partial molar free energy of oxygen in uranium oxide as a function of the O/U atomic ratio and temperature was possible. As a result, values for the partial molar heat and entropy of mixing and the corresponding relative integral quantities were calculated for the whole composition and temperature range investigated. Nonstoichiometry in the homogeneous UO_{2+x} phase is discussed. The solubility of oxygen in this phase was found to be higher than previously known. (auth)

18861 THE CRYSTAL STRUCTURE OF ALUMINUM NIOBIUM OXIDE ($AlNbO_4$). Berit F. Pedersen (Central Inst. for Industrial Research, Oslo). Acta Chem. Scand., 16: 421-30(1962). (In English)

The crystal structure of aluminum niobium oxide was determined by two-dimensional x-ray methods. The oxide crystallizes in the monoclinic system, space group C2/m, with a cell content of 4 $AlNbO_4$, and the unit cell dimensions, a = 12.13, b = 3.726, c = 6.46 Å, β = 107.2°. The structure may be described as built up of distorted oxygen-octahedra sharing edges and corners, and linked together to give an infinite three-dimensional network. Both the aluminum and niobium atoms are located in octahedral positions. (auth)

18862 DETERMINATION OF THE SOLUBILITY PRODUCT OF THORIUM TETRAFLUORIDE. N. S. Nikolaev and Yu. A. Luk'yanychev. Atomnaya Energ., 12: 334-6(Apr. 1962). (In Russian)

The solubility of ThF_4 in perchloric acid was found to increase with increasing concentration of the acid. The dissolution process may be expressed generally by the following equation: $ThF_4 + (4-n)H^+ \rightleftharpoons ThF_n^{4-n} + (4-n)HF$. The solubility was measured in 1.09 M and more dilute solutions of perchloric acid; the equilibrium constant of the dissolution reaction $ThF_4 + 3H^+ \rightleftharpoons ThF^{3+} + 3HF$ was found to be equal to 8.1×10^{-11}. For the solubility product, a value of 4.5×10^{-26} was obtained, taking into account the effect of complex formation and hydrolysis. The deviation from the previously reported value of I. V. Tananaev and A. D. Vinogradova (Zhur. Neorg. Khim. 2: 2455 (1957)) is due to the fact that those authors disregarded the effect of complex formation and hydrolysis. (TTT)

18863 COMBINATIONS FORMED BY SULFIDES OF THE ELEMENTS OF THE RARE EARTHS GROUP. IV. THE SYSTEM YTTRIUM SULFIDE–CHROMIUM(II) SULFIDE. COMBINATIONS FORMED BETWEEN YTTRIUM SULFIDE AND IRON(II) SULFIDE. Jean Flahaut, Louis Domange, and Madeleine Patrie (Laboratoire de Chimie Minérale, Faculté de Pharmacie, Paris). Bull. soc. chim. France, No. 1, 157-9(Jan. 1962). (In French)

In the Y_2S_3–CrS system, two definite compounds CrY_4S_7 and CrY_2S_4 were characterized. CrY_2S_4 is stable only above 1230 ± 20°C. Only the compound FeY_4S_7 was found in the study of the Y_2S_3–FeS system in the temperature range from 800 to 1350°C. (J.S.R.)

18864 COMBINATIONS FORMED BY THE SULFIDES OF THE ELEMENTS OF THE RARE EARTHS GROUP. V. GENERAL VIEW ON THE SYSTEMS FORMED BY YTTRIUM SULFIDE WITH THE SULFIDES OF DIVALENT ELEMENTS. Jean Flahaut, Louis Domange, and Madeleine Patrie (Laboratoire de Chimie Minérale, Faculté de Pharmacie, Paris). Bull. soc. chim. France, No. 1, 159-63 (Jan. 1962). (In French)

A general description is given of the conditions for the formation of monoclinic MY_4S_7 and MY_2S_4 compounds of varied structure. The role of the dimensions of the M^{2+} ions is discussed. Face-centered cubic solid solutions were formed by the addition of Y_2S_3 to sulfides of the NaCl type. The ion dimensions do not explain all the characteristics of these compounds or solid solutions, which are not purely ionic. M represents Mg, Mn, Ca, Pb, Sr, Ba, Cr, Fe, Zn, and Cd. (tr-auth)

18865 VIBRATIONALLY INDUCED PERTURBATIONS IN MOLECULAR ELECTRON DISTRIBUTIONS. Richard F. W. Bader (Univ. of Ottawa). Can. J. Chem., 40: 1164-75 (June 1962).

It is demonstrated that second-order perturbation theory is useful in determining the manner in which the electron density present in a molecule is changed during a nuclear vibration. Furthermore, it is shown that one nuclear motion will lead to a particularly favorable electronic distortion such that this motion is energetically favored over the other possible motions of the molecule. This allows the theory to be employed to predict the symmetry of the reaction coordinate in both unimolecular and bimolecular reactions. The chemical implications of the electron density changes are discussed. (auth)

18866 METAL OXIDE ALKOXIDE POLYMERS. PART V. THE HYDROLYSIS OF SOME ALKOXIDES OF TIN(IV), CERIUM(IV), AND URANIUM(V). D. C. Bradley and H. Holloway (Birkbeck Coll., London). Can. J. Chem., 40: 1176-82 (June 1962).

Polymers formed by the hydrolysis of stannic isopropoxide, ceric isopropoxide, and uranium pentaethoxide were studied by means of an ebulliometric method. The metal oxide alkoxide polymers formed from the tin(IV), cerium(IV), and uranium(V) alkoxides conform to the requirements of a structural theory. In view of the fundamental nature of the theory, a formal mathematical presentation is given. (auth)

18867 CHEMICAL NATURE OF THE URANIUM SELENIDE U_2Se_5. Parviz Khodadad (Faculté de Pharmacie, Paris). Compt. rend., 254: 1437-8(Feb. 19, 1962). (In French)

The reactions of the selenide U_2Se_5 with silver nitrate were analyzed. The principal reaction is very fast and

yields only solids. Extended reaction periods produce the gas NO, a solid (which is a mixture of silver selenide, selenium, and silver), and the filtrate containing all the uranium in the form of uranyl salts. The formulas describing these reactions are given. This selenide assures a transition between the ionic uranium selenide and the covalent uranium selenide. The selenide U_3Se_5 represents an equimolecular combination of the selenides USe_2 and U_2Se_3. (J.S.R.)

18868 AN AUTOCATALYTIC MECHANISM FOR THE ELECTRODE PROCESSES IN UNBUFFERED SOLUTIONS OF LANTHANUM CHLORIDE. S. I. Zhdanov (Electrical Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 143: 902-4(Apr. 1, 1962). (In Russian)

A PE-312 polarograph was modified so that the polarization of the electrode could be rapidly reversed. A series of polarograms taken with 0.1 M unbuffered $LaCl_3$ solutions shows sharp jumps in the current strengths and the presence of hysteresis loops. These data indicate an autocalytic mechanism that is liberating hydrogen by decomposing water. With a 0.1 M LiCl solution containing 2×10^{-3} M $LaCl_3$, the instantaneous current versus time curve shows a sharp rise in current strength which is characteristic of autocatalysis. Lanthanum hydroxide or a basic salt is formed on the growing drop of mercury. It is postulated that a La amalgam may be formed. This amalgam reacts with water with the evolution of hydrogen and an increase in alkalinity of the solution. Also, autocalysis can occur due to direct reaction with water and the evolution of hydrogen. The precise mechanism of the process could not be established. (TTT)

18869 THE OXY-FLUORIDES OF ZIRCONIUM AND HAFNIUM. Yu. A. Buslaev, Yu. E. Gorbunova, and M. P. Gustyakova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 2, 195-201(Feb. 1962). (In Russian)

The starting material was $MeF_4 \cdot 3H_2O$ (Me = Zr and Hf) which was synthesized by dissolving the oxide in twice-distilled, 40% HF. Chemical analyses showed that the hydrolysis product of $ZrF_4 \cdot 3H_2O$ was the compound $ZrF_{2.5}(OH)_{1.5} \cdot 0.75\ H_2O$, and the hafnium hydrolysis compound was $HfF_3(OH) \cdot H_2O$. Thermogravimetric analyses showed three endothermic points for the zirconium oxyfluoride at 50, 136, and 254°C, and for the hafnium oxychloride at 50, 142, and 272°C. A molecule of water is lost at each of the lower temperatures, and four molecules of water are lost at the higher temperature with the formation of $ZrF_{2.5}O_{0.75}$. The initial and final products can be regarded as tetramers, and the over-all decomposition equation can be written as follows: $[Zr_4F_{10}(OH)_6 \cdot H_2O] \cdot 2H_2O \xrightarrow[50 \text{ and } 132°]{-2H_2O} Zr_4F_{10}(OH)_6 \cdot H_2O \xrightarrow[236°]{-4H_2O} Zr_4F_{10}O_3$.

The dehydration of the hafnium oxyfluoride $Hf_4F_{12}(OH)_4 \cdot 4H_2O$ is analogous. X-ray analysis show that the compounds $Zr_4F_{10}(OH)_6 \cdot 3H_2O$ and $Hf_4F_{12}(OH)_4 \cdot 4H_2O$ give similar reflections and intensities because of the isomorphous replacement of the hydroxyl group by a fluoride ion. The oxyfluorides $Zr_4F_{10}O_3$ and $Hf_4F_{12}O_2$ are isomorphous. In air at 350°C the tetramer $Hf_4F_{14}O$ converts to the oxyfluoride $HfOF_2$ which is isomorphous with $ZrOF_2$. (TTT)

18870 THE SILICATES OF THE RARE EARTH ELEMENTS. PART 7. SOLID SOLUTIONS OF THE LANTHANUM AND SAMARIUM SILICATES, AND OF THE GADOLINIUM AND DYSPROSIUM SILICATES. I. A. Bondar, F. Ya. Galakhov, and N. A. Toropov (Inst. of Chemistry and Silicates, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 3, 377-82(Mar. 1962). (In Russian)

It had been shown previously that the silicates of Ce, Pr, Nd, Sm and Eu belong to the lanthanum sub-group, those of Dy, Ho and Y to the gadolinium sub-group, and those of Yb and Sc to the lutetium sub-group. Silicate samples were prepared by firing a mixture of the oxide and crystalline silica (99.90% SiO_2) in a platinum-rhodium (40% Rh) furnace at 1500 to 2000°C. Phase diagrams are presented for the systems $La_2O_3 \cdot 2SiO_2$ and $Sm_2O_3 \cdot 2SiO_2$, $2Gd_2O_3 \cdot 3SiO_2$ and $2Dy_2O_3 \cdot 3SiO_2$, and for $La_2O_3 \cdot SiO_2$ and $Sm_2O_3 \cdot SiO_2$. The data show that a simple type of solid solution without minima or maxima is formed in all cases. X-ray analysis indicated the similarity in structure for the same type of silicates, and the continuous decrease in interplanar distances due to the lanthanide contraction as La is replaced by Sm or Gd by Dy. (TTT)

18871 THE SILICATES OF THE RARE EARTH ELEMENTS. PART 8. SOLID SOLUTIONS BETWEEN THE SILICATES OF LANTHANUM AND YTTERBIUM. I. A. Bondar (Inst. of Chemistry and Silicates, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 3, 383-8(Mar. 1962). (In Russian)

Phase diagrams are given for the binary rare earth silicate systems $La_2O_3 \cdot 2SiO_2$–$Yb_2O_3 \cdot 2SiO_2$ and $La_2O_3 \cdot SiO_2$–$Yb_2O_3 \cdot SiO_2$. Solid solutions are observed over the whole region of compositions except for a small section of 15 to 20% where a eutectic mixture of two solid solutions is formed. The lanthanum diorthosilicate breaks down to the orthosilicate and a glass on melting, while the ytterbium diorthosilicate remains intact. A limited mutual solubility of the two solid solutions is observed because of the great differences in ionic radii of the component rare earth elements, and because of structural differences in the compounds. X-ray analysis shows that the lattice parameters decrease on replacing La by Yb. In a sample having a composition of 30% $La_2O_3 \cdot 2SiO_2$ and 70% $Yb_2O_3 \cdot 2SiO_2$, a mixture of two phases can be distinguished. (TTT)

18872 THE INFRA-RED ABSORPTION SPECTRA OF ZIRCONIUM THIOCYANATE COMPLEXES. Yu. Ya. Kharitonov and I. A. Rozanov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 3, 402-7(Mar. 1962). (In Russian)

Infrared spectra were taken on solid samples of $ZrO \times (NCS)_2 \cdot MNCS \cdot 2H_2O$, where M = NH_4, K, Rb, Cs or pyridine, and also on $(PyH)_2[Zr(NCS)_6] \cdot 2H_2O$ and $ZrOCl_2 \cdot 8H_2O$ as an aid in the interpretation of the spectral data. Pressed samples of KBr or NaBr were used. The wave numbers for the absorption maxima in cm^{-1} were found to be 920 for the ZrO group, 2070 for the CN group, 830 for the CS group, ~2800 for the OH group, 1600 for δ H_2O and possibly 600 for the SC group in the thiocyanate complex of Zr. It is concluded that the complex having the empirical composition $ZrO(NCS)_2 \cdot MNCS \cdot 2\ H_2O$ contains a zirconyl group ZrO and thiocyanate groups connected with the zirconium atom through a nitrogen atom. There are apparently hydrogen bonds in the compound. These conclusions are in agreement with the formula $[ZrO(NCS)_2\ H_2O] \cdot H_2O$. The compound $ZrOCl_2 \cdot 8H_2O$ does not contain the zirconyl group. (TTT)

18873 THE THERMODYNAMIC INVESTIGATION OF AQUEOUS ELECTROLYTES TO 275°C. M. H. Lietzke and R. W. Stoughton (Oak Ridge National Lab., Tenn.). J. Chem. Educ., 39: 230-5(May 1962).

Electromotive force measurements were made up to

275°C and solubility measurements to 250°C for aqueous electrolytes. The problems associated with these measurements are discussed along with the program involved in making the experimental investigations. Graphical results are presented on the emf of the silver, silver sulfate-mercury, mercury sulfate electrode system and the silver, silver chloride-mercury, mercury chloride system. Results are also presented on the solubility of silver sulfate in various electrolyte media, thermodynamic properties of hydrochloric acid and silver sulfate, and standard electrode potential of the silver-silver chloride electrode. (N.W.R.)

18874 FORMATION OF GASEOUS DETONATION WAVES. A COMPARISON OF THE KNALLGAS-STEAM AND HEAVY KNALLGAS-HEAVY WATER MIXTURES. James A. Luker (Syracuse Univ., N. Y.). J. Chem. Eng. Data, 7: 209-10(Apr. 1962).

Data for the formation of detonation waves in the heavy knallgas-heavy water system at 100°C utilizing spark ignition (360 millijoules) in a 1-in. ID reactor of 13-foot length are presented. Formation of detonation in this system differs markedly from the knallgas-steam system at comparable conditions. These differences cannot be accounted for by the relative reaction rates of deuterium and oxygen as compared to hydrogen and oxygen. The data seem to indicate that heavy water acts not only as a diluent but as a more active inhibitor than steam. (N.W.R.)

18875 HEATS OF SOLUTION AND DERIVED THERMODYNAMIC PROPERTIES OF ALKALI-METAL BROMATES. G. E. Boyd and Fred Vaslow (Oak Ridge National Lab., Tenn.). J. Chem. Eng. Data, 7: 237-8(Apr. 1962).

The heats of solution at high dilution for pure crystalline bromates of cesium, lithium, potassium, rubidium, and sodium are presented from calorimetric measurements at 25°C. Their free energies of solution using solubility and activity coefficient data are estimated. A discussion is given of other thermodynamic properties. (N.W.R.)

18876 PARTITION FUNCTION RATIOS AND EQUILIBRIUM CONSTANTS FOR OXYGEN-18 EXCHANGE REACTIONS. S. C. Saxena, D. N. Bhatnagar, and S. Ramaswamy (Atomic Energy Establishment, Trombay, India). J. Chem. Eng. Data, 7: 240-2(Apr. 1962).

Results are presented of the partition function ratios, equilibrium constants, and vibrational frequency of normal and isotopic molecules for oxygen exchange. A few systems are discussed which have favorable equilibrium constants and show promise for setting up counter-current exchange columns for the enrichment and production of oxygen-18. The partition function ratios were calculated as a function of temperature. The exchange is between oxygen-16 and oxygen-18 in the following systems: nitrous oxide, nitrogen dioxide, nitric oxide, nitrogen trioxide radical, nitrogen dioxide radical, nitrosyl chloride, carbon dioxide, sulfur dioxide, and water. (N.W.R.)

18877 SOLUBILITY OF NOBLE GASES IN MOLTEN FLUORIDES. IN LITHIUM–BERYLLIUM FLUORIDE. G. M. Watson, R. B. Evans, III, W. R. Grimes, and N. V. Smith (Oak Ridge National Lab., Tenn.). J. Chem. Eng. Data, 7: 285-7(Apr. 1962).

The solubilities and Henry's law constants for helium, argon, neon, and xenon in molten beryllium fluoride-lithium fluoride (36–64 mole %) and lithium fluoride-potassium fluoride-sodium fluoride (46.5–42–11.5 mole %) systems at pressures from 1 to 2 atm and at 500, 600, 700, and 800°C are presented and discussed. For xenon the experiments were performed at 600, 650, 700, and 800°C because of its extremely low solubility at 500°C. The experimental measurements are also compared with the calculated solubilities using experimental values of surface tension. Enthalpy and entropy changes are presented of the noble gases in the solutions mentioned above and in sodium fluoride-zirconium fluoride (53–47 mole %) system at 1000°K. (N.W.R.)

18878 SOLUBILITY OF KRYPTON AND OXYGEN IN WATER AND AQUEOUS URANYL SULFATE SOLUTIONS AT ELEVATED TEMPERATURES. C. J. Anderson, R. A. Keeler, and S. J. Klach (Vitro Corp. of America, West Orange, N. J.). J. Chem. Eng. Data, 7: 290-4(Apr. 1962).

The solubilities of krypton and oxygen in water and uranyl sulfate solutions are presented and discussed. The solubilities are studied under homogeneous reactor temperature and pressure conditions (100 to 300°C and 110 to 2015 psia), low krypton partial pressures, and high oxygen overpressures. The equipment is schematically shown for the krypton solubility measurements. Henry's law constants are also presented for krypton and oxygen in the solutions. (N.W.R.)

18879 SOLUBILITY OF IRON SULFIDES. Herbert A. Pohl (E. I. du Pont de Nemours & Co., Wilmington, Del.). J. Chem. Eng. Data, 7: 295-306(Apr. 1962).

Information is presented on the forms in which iron sulfides deposit from aqueous solutions, on how solubility changes with temperature and composition of the solution, and on the kinetics and mechanism for formation and dissolution. The solubilities to be evaluated are divided into: solubility of iron sulfides in water to which only acid or base is added; and the solubility of iron sulfides in water to which other sulfide (H_2S, NaHS, etc.) and acid or base is added. Using normal chemical concepts of ionic equilibrium and its shift with ionic concentrations and temperature, and the limited data available, predicted magnitudes and changes of concentration are calculated and compared with existing values. The amount of iron which can remain in solution with H_2S present is shown to be temperature-sensitive. (N.W.R.)

18880 FORMATION OF SPIN CENTERS IN CARBONS BY OXIDATION. K. Antonowicz (Univ. of Buffalo). J. Chem. Phys., 36: 2046-53(Apr. 15, 1962).

It was found that a high concentration of electron spin centers is obtained in carbons originally heat treated to a temperature of 1000 to 2400°C by heating such carbons to 700 to 1100°C in an oxidizing atmosphere. The conditions for the most efficient formation of spin centers by oxidation are: a temperature of about 800°C or somewhat higher, gas pressure above atmospheric, and a proper duration of heating. The spins were detected using experimental techniques of paramagnetic spin resonance absorption. Spin centers were created in various types of carbons (hard, soft, and carbon blacks). The shape and width of the paramagnetic resonance line vary greatly depending on spin concentration and on the original heat-treatment temperature of the carbon. In general the g value is close to or slightly higher than that for the free electronic spins. The experiments show that the presence of spin centers in equilibrium with an oxidizing gas is the result of the operation of two opposing mechanisms, one creating and the other destroying the centers. The creation occurs as a result of a direct chemical attack on the crystal surface. The destruction at high temperature is a result of the improvement of the crystal surface by atomic diffusion. Studies of the dynamics of formation and destruction of spin centers were carried out. The temperature dependence of spin absorption indicates a continuous change in character of spin centers with change in heat-treatment temperature. For low heat treatments the spin centers show a localized broken edge-bond charac-

ter. With increasing heat-treatment temperature of a carbon the spin centers gradually change in their character into metallic conduction band electrons. (auth)

18881 STUDY OF THE ADSORPTION OF HYDROGEN, ETHANE, ETHYLENE, AND ACETYLENE ON IRIDIUM BY FIELD EMISSION MICROSCOPY. John R. Arthur, Jr. and Robert S. Hansen (Iowa State Univ. of Science and Tech., Ames). J. Chem. Phys., 36: 2062-71(Apr. 15, 1962). (IS-352)

A field emission microscope permitting precise control of iridium emitter temperature from 4 to 1700°K was used to study changes in emission patterns and work functions resulting from time and temperature dependent surface reactions in the adsorption of hydrogen, ethane, ethylene, and acetylene on iridium. The qualitative character of the emission patterns indicates a rather uniform covering of the high index faces of iridium by all species studies in the temperature range 70 to 300°K. Hydrocarbon species, once chemisorbed, are substantially immobile at temperatures below 700°K; above 700°K an intensification of emission pattern, probably due to carbonization, occurs around the edges of the 111 planes. Iridium surfaces containing adsorbed species were flashed for controlled periods of time to controlled temperatures; characteristic changes in work function resulted which were both time and temperature dependent. These experiments indicate that hydrogen is readily desorbed by iridium above 400°K, and that a large portion of adsorbed ethane is readily desorbed at 100°K, but a residue from adsorbed ethane is not desorbed below 1000°K. For a given flash time, curves representing work function as a function of flash temperature for adsorbed ethylene and acetylene show characteristic differences below 450°K but are very similar above 450°K. Results are interpreted as indicating chemisorption of ethylene, dehydrogenation of chemisorbed ethylene to form chemisorbed acetylene and chemisorbed hydrogen, desorption of chemisorbed hydrogen, dehydrogenation of chemisorbed acetylene and finally crystallization of carbon residue. (auth)

18882 POSITRON ANNIHILATION IN SOME ORGANIC COMPOUNDS. D. P. Kerr and B. G. Hogg (Univ. of Manitoba, Winnipeg). J. Chem. Phys., 36: 2109-10(Apr. 15, 1962).

The intensity I_2 and the mean life τ_2 of the long-lived component in positron decay were measured in a number of organic halides using a fast time to pulse-height converter. In general, compounds containing a chlorine atom showed an I_2 of about 16%, those containing bromine an I_2 of about 10%, and those containing iodine an I_2 of about 4%. The τ_2 values for a number of organic compounds containing chlorine varied from 1 to 2 n sec. (auth)

18883 MOLECULAR ORBITAL CALCULATIONS OF EXCITED STATES OF H_2. Joseph T. Zung and A. B. F. Duncan (Univ. of Rochester, N. Y.). J. Chem. Phys., 36: 2140-4(Apr. 15, 1962).

Energies of the lowest $^1\Sigma_g^+$ and $^3\Sigma_g^+$ states of H_2 are computed with relatively simple molecular orbital (MO) functions. The MO functions are constructed from 1s, 2s, and 2pz atomic functions, with variable orbital parameters. The MO's are kept orthonormal during extensive variation of the orbital parameters and the internuclear distance. Minimum energies of antisymmetrized products of the MO functions and corresponding best values of the orbital parameters are obtained. The final energies are somewhat inferior to values obtained by Kolos and Roothaan for the singlet state and James and Cooledge for the triplet state, but are better than values obtained with one-center functions. The final functions satisfy the virial theorem at R close to the experimental equilibrium value. (auth)

18884 NUCLEAR MAGNETIC RESONANCE SPECTRUM OF B^{11} IN LESSERITE. K. S. Pennington and H. E. Petch (McMaster Univ., Hamilton, Ont.). J. Chem. Phys., 36: 2151-5(Apr. 15, 1962).

The quadrupolar splitting of the B^{11} nuclear magnetic resonance signal in a single crystal of lesserite, the monoclinic dimorph of $Mg_2B_6O_{11} \cdot 15\ H_2O$, was investigated in a magnetic field of 6345 gauss. The spectra obtained as the crystal was rotated in turn about three mutually perpendicular axes held normal to the magnetic field were interpreted on the basis that the 12 B^{11} sites per unit cell belong to three distinct types with the four sites of each type related by the symmetry of point group 2/m. The electric quadrupole coupling constants, eqQ/h, and asymmetry parameters η of the electric field gradient tensors at the three unique B^{11} sites were determined to be:

eqQ/h	406 ± 4 kc/sec	270 ± 4 kc/sec	2529 ± 10 kc/sec
η	0.397 ± 0.002	0.927 ± 0.002	0.075 ± 0.003

It was inferred from the values that two of the boron atoms in the asymmetric unit of lesserite have tetrahedral coordinations whereas the third has triangular coordination and that the two BO_4 groups form with the BO_3 group a closed-ring polyion similar to that found in colemanite. The orientations of the principal axes of the electric field gradient tensors at the B^{11} sites were also determined. (auth)

18885 DOUBLE-OVEN EXPERIMENTS WITH LITHIUM HALIDE VAPORS. J. Berkowitz, H. A. Tasman, and W. A. Chupka (Argonne National Lab., Ill.). J. Chem. Phys., 36: 2170-9(Apr. 15, 1962).

A double-oven apparatus described was operated within a mass spectrometer. By independently controlling the pressure and temperature of the vapor in the oven, the fragmentation patterns and relative ionization cross sections of the components of a complex vapor phase may be distinguished. Superheating the vapor and thereby producing species of lower molecular weight simplifies the mass spectrum and minimizes confusion due to fragmentation effects. This technique was applied to the lithium halide vapors. Fragmentation patterns, ionization cross sections of dimers relative to those of the monomers, and energies of dimerization are reported. (auth)

18886 EFFECTS OF HELIUM BUFFER GAS ATOMS ON THE ATOMIC HYDROGEN HYPERFINE FREQUENCY. George A. Clarke (Columbia Univ., New York). J. Chem. Phys., 36: 2211-16(Apr. 15, 1962).

Calculations are made for the pressure, mass, and temperature dependence of the atomic hydrogen hyperfine frequency shift arising from the perturbing influence of helium buffer gas atoms. The calculated fractional pressure shift is found to be $+1.73 \times 10^{-9}$ mm Hg^{-1} compared with the experimental value of $+3.7 \times 10^{-9}$ mm Hg^{-1}. This discrepancy may be related to a failure of the simple wave function employed to adequately characterize the unpaired electron spin density at the hydrogen nucleus. The results of the calculations for the temperature variation and mass dependence indicate that these are very small effects. The form of the mass dependent quantum statistical correction, used to elucidate the mass effect, suggests that the relatively large variations experimentally observed with other buffer gases, due to hydrogen isotope variation, are in error. A calculation is made for the pressure shift from a kinetic theory point of view and the result obtained ($+1.79 \times 10^{-9}$ mm Hg^{-1}) is in fair agreement with the above mentioned quantum statistical calculation. (auth)

18887 NUCLEAR RELAXATION IN ADULTERATED HYDROGEN. C. S. Johnson, Jr. and J. S. Waugh (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 36: 2266-72(May 1, 1962).

The proton spin-lattice relaxation time T_1 was measured in normal hydrogen and in mixtures with 12 other gases as a function of density and composition at room temperature. Cross sections for m_j transitions of the H_2 molecule deduced from the Bloembergen-Schwinger formula are interpreted qualitatively on the basis of electric multipole moments as measures of the anisotropy of the intermolecular forces, using the transient approximation. This approximation is justified in the case of H_2-CO_2 mixtures on the basis of the temperature dependence of T_1. The assumptions of the Bloemberger-Schwinger formula are discussed, and an experiment is proposed to determine the connection between two correlation times which appear in the theory. (auth)

18888 STRUCTURE OF THE HYDROGEN-BONDED WATER MOLECULE IN CRYSTALS. R. Chidambaram (Indian Inst. of Science, Bangalore, India). J. Chem. Phys., 36: 2361-5(May 1, 1962).

A correlation of the structural data on 15 hydrates obtained by x-ray diffraction, neutron diffraction, and proton magnetic resonance reveals that when a water molecule is hydrogen bonded into a crystal structure and the angle subtended at the donor water oxygen by the acceptor atoms deviates from the vapor H–O–H angle, bent hydrogen bonds are formed in preference to distortion of the H–O–H angle. Theoretical justification for this result is obtained from energy considerations by calculating the energy of formation of bent hydrogen bonds on the basis of the Lippincott-Schroeder potential function model for the hydrogen bond and the energy of deformation of the H–O–H angle from spectroscopic force constants. (auth)

18889 VIBRATIONAL SPECTRA OF INORGANIC MOLECULES. IV. INFRARED REFLECTION SPECTRA OF LIQUID LITHIUM, SODIUM, POTASSIUM AND SILVER CHLORATES, AND LIQUID LITHIUM PERCHLORATE. J. K. Wilmshurst (Union Carbide Corp., Parma, Ohio). J. Chem. Phys., 36: 2415-19(May 1, 1962).

Infrared reflection spectra of molten lithium, sodium, potassium, and silver chlorates and lithium perchlorate were obtained from 2900-200 cm^{-1} and the optical constants derived. In both lithium and silver chlorate, the anion is not rotating freely about its threefold axis, and the point group symmetry of the cations about the chlorate ion does not contain a threefold rotation axis. In lithium perchlorate, it appears that the anion may be rotating freely. The presence of a lattice-like vibration band in each melt is apparent and a dielectric constant of 1.9-2.9 can be estimated from extrapolation of the low frequency refractive index data for liquid lithium perchlorate. Integrated band areas are recorded for all the materials investigated. (auth)

18890 TWO-CENTER, NONINTEGRAL, SLATER-ORBITAL CALCULATIONS: INTEGRAL FORMULATION AND APPLICATION TO THE HYDROGEN MOLECULE–ION. Murray Geller (Carnegie Inst. of Tech., Pittsburgh). J. Chem. Phys., 36: 2424-8(May 1, 1962).

Integrals over Slater orbitals of nonintegral principal quantum numbers centered at two nuclei are investigated, with special reference to the hydrogen molecule-ion. All the one-electron integrals for s orbitals are evaluated in closed form. For the hydrogen molecule-ion, a wave function of the generalized Finkelstein-Horowitz form $\Psi = ns_a + ns_b$, where $ns = Nr^{n-1}e^{-\zeta r}$, N being the normalization constant, n the principal quantum number, and ζ the orbital exponent, is shown to give a total energy E = −0.588085 amu for n = 1.05759 and R = 1.9866 a_0 as compared with the corresponding Finkelstein-Horowitz calculation E = −0.586507 amu at n = 1 and R = 2.0033 a_0, where the exact values are E = −0.60263 amu at R = 2.000 a_0. More general one-electron integrals and some two-electron integrals are discussed. (auth)

18891 RESONANT GAMMA-RAY ABSORPTION IN POTASSIUM FERRATE. G. K. Wertheim (Bell Telephone Labs., Murray Hill, N. J.) and R. H. Herber. J. Chem. Phys., 36: 2497-9(May 1, 1962).

The Mössbauer spectrum in a potassium ferrate absorber was determined at 78 and 298°K using a source of Co^{57} in stainless steel. A single resonance line is observed with a full width at half-maximum of 0.43 mm sec^{-1}. This linewidth is known to arise mainly in the stainless-steel source, which indicates that the quadrupole splitting of the resonance peak is less than 1 mc sec^{-1}. The isomer shift is −0.69 mm sec^{-1} at 78°K and −0.79 mm sec^{-1} at 298°K. This shift is smaller than that predicted for a $3d^2$ electron configuration, presumably because the 3d electron density is augmented by d^3s hybridization in the tetrahedral ferrate ion. (auth)

18892 LATTICE ENERGIES OF COMPOUNDS OF THE TRANSITION-TYPE METALS. M. F. C. Ladd and W. H. Lee (Battersea Coll. of Tech., London). J. Inorg. & Nuclear Chem., 23: 199-205(Dec. 1961). (In English)

Empirical Madelung constants are calculated for the oxides and halides of the lanthanide and actinide series of elements. The variation of lattice energy with atomic number of the cation throughout these series is compared with the similar variation for the first transition series. It appears likely that the 5f shell, rather than the 6d, is progressively filled in these actinide compounds. The lattice energy variations in the first transition series are shown to be closely paralleled by variations in terms which relate only to the metals. (auth)

18893 PREPARATION AND THERMAL STABILITIES OF SOME METAL CHELATE POLYMERS OF NAPHTHAZARIN. R. S. Bottei and P. L. Gerace (Univ. of Notre Dame, Ind.). J. Inorg. & Nuclear Chem., 23: 245-51(Dec. 1961). (In English)

Metal chelate polymers were prepared from naphthazarin and the divalent metal ions: Co, Ni, Zn, Cu, and Be. The chelates are fine deliquescent powders which are insoluble in a wide variety of polar and non-polar solvents. The metal to ligand ratio is one to one for all chelates, except for the copper chelate which has a ratio of three to four. The Co, Ni, and Zn chelates are hydrates, while the Cu and Be chelates are not. Thermal stabilities of the chelates were determined using a manually-operated thermobalance, which was constructed from readily available equipment. The order of thermal stability of the chelates based on procedural decomposition temperatures is: Be > Ni > Zn > Co > Cu. Static heating showed the beryllium and nickel chelates to be stable up to 316°C. An attempt is made to account for the observed order of stability. Several unsuccessful attempts were made to prepare a beryllium-naphthazarin (1 : 2) complex and also a platinum(II)–naphthazarin complex. (auth)

18894 THE INTERACTION OF GRAPHITE WITH SODIUM-VAPOUR. A PRELIMINARY INVESTIGATION. H. L. Recht (Astropower, Inc., Costa Mesa, Calif.), G. M. Wolten, and D. E. Gilmartin. J. Inorg. & Nuclear Chem., 23: 725-8(Dec. 1961). (In English)

The sorption of sodium vapor by graphite was studied as

a function of temperature, sodium vapor pressure, inert gas pressure, and number of sorption-desorption cycles. Preliminary information on the kinetics of the reaction and the products formed was obtained. The uptake of sodium vapor by graphite became less with increasing temperature. Heating graphite to 850°C under a vacuum removed any sodium previously taken up. While the equilibrium amount of sodium in the graphite was greater at lower temperatures, the rate of the reaction decreased markedly, and it was difficult to achieve equilibrium below 400°C. Between 500 and 750°C the rate was fast, while at the same time the equilibrium amount of sodium taken up was still large enough for meaningful measurements. In a number of experiments, weight gains were experienced which were far in excess of the values claimed to constitute equilibrium. A reversible function of inert gas pressure was a feature of the high weight gains. (P.C.H.)

18895 AQUEOUS SYSTEMS AT HIGH TEMPERATURE. IV. COMPOSITIONS OF LIGHT- AND HEAVY-LIQUID PHASES IN THE SYSTEMS $UO_3-SO_3-H_2O$ AND $UO_3-SO_3-D_2O$, 280-350°C. Ernest V. Jones and William L. Marshall (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 23: 287-93(Dec. 1961). (In English)

The system $UO_3-SO_3-H_2O$ at high temperature is characterized by a range of compositions in which liquid-liquid immiscibility occurs. Some equilibrium compositions of the two liquid phases with vapor present in this system and its D_2O analogus were determined from 280 to 350°. The nature of the equilibrium is unusual since at 350° in certain parts of the systems the light-liquid phase, 0.02 to 0.1 molal in SO_3, is in equilibrium with a heavy-liquid phase, 9 molal in SO_3. The light-liquid phases contain an excess of free H_2SO_4 whereas the heavy-liquid phases either are stoicheiometric in UO_2SO_4 or contain a small excess of free H_2SO_4 or UO_3. Comparative liquid-phase compositions in the analogous D_2O system showed little difference in composition in the heavy-liquid phases but indicated approximately 10 per cent lower saturation molal ratios, $m_{UO_3}: m_{SO_3}$, for the light-liquid phases. (auth)

18896 AQUEOUS SYSTEMS AT HIGH TEMPERATURE. V. DISTRIBUTION OF CuO AND NiO COMPONENTS IN THE TWO-LIQUID PHASE REGION OF THE SYSTEM $UO_3-SO_3-H_2O$ AND ITS D_2O ANALOGUE, 300-350°C. Ernest V. Jones and William L. Marshall (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem., 23: 295-303(Dec. 1961). (In English)

Some equilibrium compositions of light- and heavy-liquid phases with vapor present in the systems $UO_3-CuO-SO_3-H_2O$, $UO_3-NiO-SO_3-H_2O$, and $UO_3-CuO-NiO-SO_3-H_2O$ and in their corresponding D_2O analogues were determined at 300, 325, and 350°. Concentrations of CuO and NiO were kept relatively low; thus the predominant components were UO_3, SO_3, and H_2O or D_2O. The summation of the molal ratios, $m_{UO_3}: m_{SO_3}$, $m_{CuO}: m_{SO_3}$, and $m_{NiO}: m_{SO_3}$ for each liquid phase gave values close to the molal ratio, $m_{UO_3}: m_{SO_3}$, in the system $UO_3-SO_3-H_2O$ or its D_2O analogue at the same SO_3 concentration. At 350° and a summation ratio near unity the heavy-liquid phases contain 6-7 moles of H_2O per mole of SO_3. (auth)

18897 THERMODYNAMICS OF SOLUTION OF SOME INNER COMPLEX SALTS. M. M. Jones, J. L. Wood, and W. R. May (Vanderbilt Univ., Nashville). J. Inorg. & Nuclear Chem., 23: 305-9(Dec. 1961). (In English)

An examination was made of the solubility behavior of nine typical inner complex salts. It was found that the solubility characteristics are quantitatively similar to solutions of organic compounds in organic solvents in at least some respects. In a few cases nearly regular solutions are found. Provisional values of Hildebrand's solubility parameter, δ, were determined for several of the compounds to assist in incorporating the prediction of their solubilities into the general pattern used for typical covalent compounds. Values of $\Delta F°$, $\Delta H°$, and $\Delta S°$ are tabulated for the systems studied. (auth)

18898 THE ION EXCHANGE AND OTHER PROPERTIES OF CERTAIN 12-MOLYBDOPHOSPHATES. R. W. C. Broadbank, S. Dhabanadana, and R. D. Harding (Leicester Coll. of Tech. and Commerce, Eng.). J. Inorg. & Nuclear Chem., 23: 311-16(Dec. 1961). (In English)

Potassium, rubidium, and cesium 12-molybdophosphates are all effective ion exchangers for the concentration of traces of cesium, strontium, and yttrium from neutral solution, but retain only cesium in 2 M nitric acid. None appears to have any advantage over ammonium 12-molybdophosphate in this connection. Methylammonium 12-molybdophosphates are poor exchangers for the cations studied. The molecular weights and solubilities of these 12-molybdophosphates were also determined. (auth)

18899 THE VISCOSITY OF LIQUID METALS AND AN EMPIRICAL RELATIONSHIP BETWEEN THEIR ACTIVATION ENERGY OF VISCOSITY AND THEIR MELTING POINTS. A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. & Nuclear Chem., 23: 333-9(Dec. 1961). (In English)

It is shown that a simple empirical relationship exists between the activation energy of viscosity for liquid metals and their melting points. This relationship coupled with Da Andrade's expression for the viscosity of the liquid metal at the melting point (T_{mp}): η_{mp}(in poises) $= 5.7 \times 10^{-4} \cdot [\sqrt{(A \cdot T_{mp})}]/V_A^{\frac{2}{3}}$ (A = At. wt; V_A = liq at. volume at mp; °K) permits the estimation of the viscosity of any metal having a closepacked crystal structure, one for which the Andrade relationship holds, at any temperature. All available experimental data on the viscosity of metals were used to establish an empirical relationship. (auth)

18900 THE RAMAN SPECTRUM OF MONODEUTEROMETHANE. E. H. Richardson, S. Brodersen, L. Krause, and H. L. Welsh (Univ. of Toronto). J. Mol. Spectroscopy, 8: 406-25(May 1962).

The Raman spectrum of CH_3D was photographed at a gas pressure of ~1 atm. with a reciprocal linear dispersion of 3 to 5 cm^{-1} per mm. Extensive rotational structure was observed for the ν_2 and ν_4 bands and analyzed by a least squares method with an electronic computer. Assignment of the lines of the ν_4 band was facilitated by intensity profiles of the band electronically computed from approximate values of the molecular constants. Essential constants obtained from these analyses are: $A_0 = 5.243$, $B_0 = 3.878$ cm^{-1}, $\zeta_4 = 0.0775$, $r_0(C-H) = 1.0937 \pm 0.0002$, $r_0(C-D) = 1.0928 \pm 0.0002$ Å (assuming a tetrahedral HCD angle). The band origins of the ν_2 and ν_4 bands are at 2200.00 and 3016.59 cm^{-1}, respectively. A strong line observed near the band origin of the ν_4 band appears to indicate a breakdown of the $\Delta K = 0$ selection rule. The ν_1, $2\nu_3$, and $2\nu_6$ bands were also observed. (auth)

18901 THE CATALYST-FORMING REACTION BETWEEN TRIMETHYLALUMINUM AND TITANIUM TRICHLORIDE. L. Rodriguez and J. Gabant (European Research Associates, s.a., Brussels). J. Polymer Sci., 57: 881-93(Mar. 1962).

The reaction between $TiCl_3$ and trimethylaluminum, in the absence of a solvent, yields methane, dimethylaluminum chloride, and a nonvolatile phase containing titanium, chlorine, aluminum, carbon, and hydrogen which is an active

polymerization catalyst. From the rate of formation of the volatile dimethylaluminum chloride and the measured stoichiometry of the reaction it is concluded that in the first step of the reaction dimethylaluminum chloride is formed, together with a nonvolatile product in which a fraction of the chlorine atoms originally present is replaced by methyl groups (alkylation). A general scheme of reaction is proposed, which is consistent with the experimental results. According to the scheme, each of the methyl groups fixed in the first reaction step to the nonvolatile product is able to react further with trimethylaluminum in excess, yielding methane and a nonvolatile phase which is catalytically active. This catalyst, after exhaustive reaction with trimethylaluminum, contains (in addition to Ti and Cl) aluminum, carbon, and hydrogen in the ratio of 1:2:4. Alkyl exchange between the catalyst and all-deuterated trimethylaluminum permit the conclusion that only complete methyl groups exchange and that these acount for about half of the carbon removable from the catalyst by hydrolysis. (P.C.H.)

18902 VACUUM ULTRA-VIOLET ABSORPTION SPECTRA OF FLASH-HEATED LEAD REACTING WITH VARIOUS GASES. Jack G. Kay (Univ. of Illinois, Urbana), N. A. Kuebler, and L. S. Nelson. Nature, 194: 671(May 19, 1962).

Lead was flash-heated in various gases and absorption spectra taken in the region 1300 to 3300 A at times from 0 to several thousand μsec after the flash. All spectra taken within a few msec after the flash show lines due to Pb atoms in ground state and excited states. PbF was formed in CF_4 or SF_6. PbO was produced in O_2 or CH_4 + air impurity. Unidentified lines are reported, some of which are tentatively assigned to $Pb_2(g)$. (D.L.C.)

18903 NOTES ON ISOTOPIC EXCHANGE REACTIONS. I. STEPWISE SEPARATING PROCESS. Kenji Ishida, Junichi Shimokawa, and Yutaka Yamamoto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakaishi, 4: 239-43(Apr. 1962). (In Japanese)

It is difficult to experimentally determine the separation factor for the isotopic exchange reaction with a small equilibrium constant, even if the equilibrium constant can theoretically be evaluated. As a method to determine the separation factor of such an isotopic exchange reaction, the stepwise separating process, which also may be regarded as a simple cascade, is investigated. (auth)

18904 THE STRUCTURE OF LIQUID BROMINE. G. Caglioti and F. P. Ricci (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). Nuovo cimento (10), 24: 103-10(Apr. 1, 1962). (In English)

The neutron diffraction pattern of liquid bromine near the melting point is obtained up to a very large value of $4\pi \sin\theta/\lambda$ by means of a crystal spectrometer. Analysis of the intensity data leads to a radial distribution function showing that, in the liquid at room temperature, the bromine molecules are not freely rotating. Moreover, on a short-range order scale, it seems that the main features of the structure of the parent solid are preserved during the melting process. (auth)

18905 VAPOUR PRESSURE OF ISOTOPIC LIQUIDS. IV. CO, N_2, O_2, ABOVE BOILING-POINT. E. Ancona, G. Boato, and G. Casanova (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo cimento (10), 24: 111-21(Apr. 1, 1962).

The separation factor α in the liquid-vapor equilibrium of the isotopic diatomic systems $CO^{12}-CO^{13}$, $N_2^{14}-N^{14}N^{15}$, and $O_2^{16}-O^{16}O^{18}$ was measured in the temperature range from boiling point to a vapor pressure of about 12 atm. Natural and enriched mixtures were used. Agreement with measurements carried out in a lower temperature range, using separated isotopes, was found for all systems, thus confirming the reliability of the static equilibration method. An approximate linear dependence of $\ln \alpha$ on $1/T^2$ was found in the range of existence of the liquid explored. (auth)

18906 THE HEAT OF MIXING OF THE LIQUID SYSTEMS H_2-D_2, H_2-HD AND $HD-D_2$. H. F. P. Knaap, R. J. J. Van Heijningen, J. Korving, and J. J. M. Beenakker (Kamerlingh Onnes Laboratorium, Leiden). Physica, 28: 343-52(Apr. 1962).

Heat of mixing in the liquid state was measured for the systems nH_2-nD_2, nH_2-HD, and $HD-nD_2$ at 20.4°K over the entire concentration range. In all cases a cooling was found. The results agree rather well with predicted theoretical values. The solutions are not regular since the excess entropies are different from zero. Data are tabulated. (auth)

18907 ANHARMONICITY FACTORS AND POTENTIAL ENERGY CONSTANTS OF B_2H_6 AND B_2H_6. K. Venkateswarlu and M. Radhakrishnan (Annamalai Univ., Annamalainagar, South India). Proc. Indian Acad. Sci., Sec. A, 55: 161-7 (Mar. 1962). (In English)

Anharmonicity factors of B_2H_6 and B_2D_6 were calculated using Dennison's method. Using the calculated harmonic wave numbers, the valence force constants were obtained by the Wilson's F-G matrix method. (auth)

18908 THE BIOSYNTHESIS OF CARBON-14-LABELLED COMPOUNDS. I. PREPARATION OF ^{14}C-LABELLED STARCH, D-GLUCOSE, D-FRUCTOSE AND SUCROSE BY MEANS OF PHOTOSYNTHESIS. Tetsuyoshi Yokoshima and Masaru Hasegawa (Daiichi Pure Chemicals Co., Ltd., [Japan]). Radioisotopes (Tokyo), 10: 435-42 (Dec. 1961). (In Japanese)

C^{14}-labelled starch, D-glucose, D-fructose, and sucrose were prepared in a good yield by means of photosynthesis from a tobacco leaf exposed to an atmosphere of $C^{14}O_2$ and to the light. In the preliminary work, some conditions of the photosynthesis method were re-examined and the optimum conditions determined. Following these conditions the tobacco leaf was allowed to perform the photosynthesis in the presence of 38.8 mc of $C^{14}O_2$. The leaf was killed and extracted with 80% ethanol. The starch of total activities 14.2 mc was extracted from the ethanol insoluble. The starch was then hydrolyzed to D-glucose by dissolving it in sufficient water to make a 0.2% solution, adding an equal volume of 2 N H_2SO_4 and refluxing the mixture for 8 hours in the oil bath (125 ~ 130°). The reaction mixture yielded D-glucose. The mixture of D-glucose, D-fructose and sucrose in the 80% ethanol extracts was separated by cellulose column chromatography. After the removal of the ethanol and the chlorophyll, the solution was deionized through ion exchange resin. The deionized sugar solution was concentrated to a small volume in vacuo and added to the cellulose column. The column was developed with 95% n-butanol and then eluted the D-fructose and the D-glucose using the same solvent. After most of the D-glucose was eluted, the composition of the solvent was changed to elute the sucrose. Using this method pure 5.2 mc of D-fructose, 5.3 mc of D-glucose, and 6.8 mc of sucrose were obtained. (auth)

18909 PREPARATION OF RADIOCYANOCOBALAMIN-^{60}Co. Yasuo Minaki, Chihiro Sekijo, and Shinsuke Ose (Dainippon Pharmaceutical Co., Ltd., Japan). Radioisotopes (Tokyo), 10: 443-7(Dec. 1961). (In Japanese)

When cobalt-60 was added in the fermentation medium of Streptomyces griseus, cyanocobalamin (vitamin B_{12}) labeled with Co^{60} was obtained by biosynthesis. The extraction and

purification method of radiocyanocobalamin from the fermentation broth was established in consideration of improving radiochemical purity and protection against radiation. In this procedure radiocyanocobalamin was purified using the techniques of chromatography with alumina and treatment with ion exchange resins. It was evidenced by paper chromatography that the radioactive impurities were thoroughly removed by this purification procedure. Also, the method of quality test of radiocyanocobalamin solution was established. Finally, about 1 mc of Co^{60} with specific activity of 14 mc/mg was added in the fermentation medium and radiocyanocobalamin–Co^{60} was prepared. In the purified solution, radiocyanocobalamin with specific activity of 0.5 mc/mg was contained with concentration of 1.1 microns/ml. This solution was sufficiently pure for practical use. (auth)

18910 PREPARATION OF ISOTOPE-LABELED FERTILIZERS. Susumu Sonoda, Tohru Hirayama, Kazuyoshi Hamada, and Komin Osada. Radioisotopes (Tokyo), 10: 448-59(Dec. 1961). (In Japanese)

Labeled fertilizers are used as an excellent tool in making tests for fertilizer effect. It is desired that they should be developed not only in quantity but also in form. The writers have studied the quantity production of P^{32}-labeled calcium superphosphate, fused magnesium phosphate, and other compound fertilizers derived therefrom. Basic data for the method of quantity production were obtained and are outlined. In addition to the general problems encountered in the manufacture of labeled compounds, the production of labeled fertilizers present problems due to their specific nature as fertilizer. As compared with general tracer experiments, test of fertilizer effect is carried out on a broader scale and extends over a longer period. Moreover, the uptake of fertilizer element by crops is relatively low. For this reason the labeled fertilizer should have a larger total activity and specific activity than general labeled compounds. It is required that the chemical and physical properties on experimentally produced labeled fertilizers should be identical, as viewed in the light of fertilizer, to those of general types of fertilizer on which the test is to be made. As the fertilizers in common use vary widely in the form, percentage composition, particle size, etc., thorough study and analysis must be made of the labeled fertilizers so they can be handled in the same way as general nonlabeled fertilizers. The manufacture of labeled fertilizers should take into consideration the provision of sufficient shielding and other measures for prevention of contamination. In view of the foregoing problems the writers have developed a specially designed hood, one side of which is shielded with concrete. In the center of the hood is placed a motor-driven turn-table 2 meters in diameter to provide an easy remote control from the outside of the shielding wall for various units of manufacturing equipment on said table. This arrangement permits the safe handling of an amount of activity in the order of 1 curie of P^{32} from the outside of the shielding wall and the lesser activity in the order of below 10 mc directly from the opposite side. With the apparatus the labeled fertilizers were prepared which had the desired specific activity and fertilizer composition, and study was made of the process, conditions, and yield of the said manufacture and the method of securing the uniformity of composition and labeling. (auth)

18911 VAPOUR HYDROLYSIS OF DOUBLE CHLORIDES OF POTASSIUM AND RARE EARTH ELEMENTS (La, Ce, Pr, Nd). G. I. Novikov and A. K. Baev. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 154-60(1961). (In Russian)

By means of a membrane null-manometer the processes of vapor hydrolysis of the La, Ce, Pr, and Nd chlorides as well as those of double compounds such as $2KCl \cdot LaCl_3$, $3KCl \cdot 2CeCl_3$, $3KCl \cdot CeCl_3$, $3KCl \cdot 2PrCl_3$, $3KCl \cdot PrCl_3$, $3KCl \cdot 2NdCl_3$, and $3KCl \cdot NdCl_3$ were studied. On the basis of experimental data the entropies of formation of the above compounds were calculated. The compounds with one gram atom of a rare earth element are considered to be the most thermically stable. (auth)

18912 ISOTOPIC TRANSFER, EXTERNAL TRANSFER, AND SELF-DIFFUSION OF Li IN SOLID Li_2SO_4 AT 600-790°C. Arnold Lundén (Chalmers Tekniska Hogskola, Goteborg). Z. Naturforsch., 17a: 142-6(Feb. 1962). (In German)

Solid Li_2SO_4 was electrolyzed with a liquid Zn cathode and a Au–Pt anode. Li^7 was enriched at the anode. The mass effect (relative difference of the migration velocities/relative mass difference) remains practically unaltered by temperature. It is $\mu = -0.14$, which is as large as in molten halogenides. The self-diffusion coefficient of the cation was estimated from the practical range of the isotopic separation to be $D^+ = 0.015 \exp(-10{,}500/RT)$. Therefore, D^+ was measured in $cm^2\ sec^{-1}$ and R in cal $mol^{-1}\ grad^{-1}$. The activation energy is much larger than in molten salts, but the variation is not significant. The transport number of the cation was measured from the displacement of the anode as $U^+ = 1.00$. It was established that the Faraday law is valid in molten Li_2SO_4. Some questions of the eventual applications of Li_2SO_4 for the enrichment of isotopes in large quantities were discussed. (tr-auth)

18913 REACTIONS OF $ZrOCl_2$ WITH ALKALI METAL FERROCYANIDES IN ACID MEDIUM. E. A. Ionova and I. V. Tananaev. Zhur. Neorg. Khim., 7: 791-4(Apr. 1962). (In Russian)

The kinetics of fluorine reactions with $ZrO(OH)_2$ and $[ZrO(OH)]_4[Fe(CN)_6] \cdot nH_2O$ were investigated. It is shown that the hydroxyl ion reactivity in these compounds is considerably stronger than in the zirconyl oxide group. It is also shown that a normal zirconium ferrocyanide, $Zr[Fe(CN)_6]$, is formed in $ZrOCl_2$ reaction with $M_4[Fe(CN)_6]$ in strongly acid media. (R.V.J.)

18914 ON THE ZIRCONYL BEHAVIOR IN SOLUTIONS. L. M. Zaitsev and G. S. Bochkarev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 7: 795-802(Apr. 1962). (In Russian)

Reactions of F^- with compounds in which zirconium is bound with OH^- groups or with zirconyl compounds are studied. It was found that ZrO^{2+} exists only in solids while $Zr(OH)_2^{2+}$ can exist in solids and solutions. The equilibrium $ZrO^{2+} + H_2O \rightleftharpoons Zr(OH)_2^{2+}$ is easily achieved but it shifts under the smallest influence. Temperature, pH, and dehydrating agents induce zirconyl dehydration in hydrated compounds. Dehydration of solid compounds degrades the zirconyl while in solutions $Zr(OH)_2–O–Zr(OH)_3$ is formed. (R.V.J.)

18915 ON TRIVALENT VANADIUM SALICYLATES. L. B. Levashova and V. L. Zolotavin. Zhur. Neorg. Khim., 7: 811-13(Apr. 1962). (In Russian)

Absorption spectra, composition, and stability of V^{3+} salicylate $[V(C_6H_4OCO_2)]^+$ was investigated, and the instability constant, equal to 4×10^{-16}, at ionic strength $\mu_{mean} = 0.05$ was found. (R.V.J.)

18916 DETERMINATION OF THE COMPOSITION AND STABILITY OF COMPLEX COMPOUNDS BY ION EXCHANGE CHROMATOGRAPHY. L. I. Tikhonova. Zhur. Neorg. Khim., 7: 822-30(Apr. 1962). (In Russian)

The ion exchange method was used for determining the

composition and instability constants (K) of Sr^{2+} complexes with citric acid ($K = (5.7 \pm 0.1) \times 10^{-9}$) at pH 7.2, diethylenetetraaminepentaacetic acid ($K = (2.7 \pm 0.4) \times 10^{-18}$) at pH 7.2, and tetraacetic acid $K = (3.8 \pm 0.1) \times 10^{-9}$ at pH 7.2. Complex 1:1 compounds with $K = (1.98 \pm 0.05) \times 10^{-18}$ (pH = 2.6), $K = (2.1 \pm 0.3) \times 10^{-16}$ (pH = 3.0) and $(3.2 \pm 0.3) \times 10^{-16}$, (pH = 3.5) are formed by Y^{3+} and Ce^{3+} with ethylenediaminetetraacetic acid. Composition and instability constants of Ce^{3+} with 2,2'-diaminodiethyl ether N,N,N',N' tetraacetic acid, $K(1.35 \pm 0.07) \times 10^{-18}$ at 3.5 pH was determined as well as the $K_0(Sr^{2+} - KR)$pH 7.2 = 17.5 ± 0.7. (R.V.J.)

18917 TRANSFORMATION OF CeO_2, Nd_2O_3 AND Sm_2O_3 AND THEIR REACTION WITH MOLTEN LITHIUM AND POTASSIUM CHLORIDES AND SODIUM CARBONATES AND SULFATES. N. K. Voskresenskaya and S. I. Berul (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zhur. Neorg. Khim., 7: 850-5(Apr. 1962). (In Russian)

Thermographic studies of $Nd(OH)_3$, $Sm_2O_3 \cdot 1.6\ H_2O$, and CeO_2 indicated that CeO_2 remains unchanged after heating and annealing while $Nd(OH)_3$ becomes hydrous in transition from $Nd_2O_3 \cdot H_2O(NdO \cdot OH)$ and $Nd_2O_3 \cdot \frac{1}{2}\ H_2O$. The $Sm_2O_3 \cdot 1.6\ H_2O$ becomes anhydrous in transition through $Sm_2O \cdot H_2O$ into Sm_2O_3. The first Nd_2O_3 modification was found at 700 and 1000°C. With 700°C annealing, many lines of the Nd_2O_3 record modification were observed. The record modification of Sm_2O_3 was observed at 500 to 600°C. X-ray pictures also exhibited NdOOH and SmO·OH lines. Isothermal studies were made of the rare earth transitions into KCl and LiCl melts. (R.V.J.)

18918 EFFECTS OF ZIRCONIUM IONS IN SOLUTION ON ITS REACTION WITH ORGANIC REAGENTS. A. K. Babko and G. I. Gridchina (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zhur. Neorg. Khim., 7: 889-95(Apr. 1962). (In Russian)

The influence of Zr ionic state on the rate of formation of zirconium-xylenol orange compounds was studied. A complete zirconium reaction was observed after heating with 2 to 5 N hydrochloric acid. A non-reactive condition of zirconium was also achieved by heating at pH 2 with 50 γ of thorium and 10 γ aluminum. Larger amounts of zirconium increase the coloring. (R.V.J.)

18919 THORIUM SORPTION BY CATIONITES. A. I. Zhukov, E. I. Kazantsev, and V. N. Onosov (Ural Polytechnic Inst., USSR). Zhur. Neorg. Khim., 7: 915-20(Apr. 1962). (In Russian)

Studies of thorium sorption from 0.025 mole solutions of thorium nitrate and thorium chloride on resin showed that sorption depends on pH, Th concentration, and the resin swelling. Increased Th sorption was observed as a result of hydrolyzed ion sorption. (R.V.J.)

18920 COMPOSITION OF THORIUM IONS SORBED BY A RESIN. A. I. Zhukov, V. N. Onosov, and E. I. Kanzantsev (Ural Polytechnic Inst., USSR). Zhur. Neorg. Khim., 7: 921-5(Apr. 1962). (In Russian)

The composition of thorium ions sorbed on KU-1 resin was determined, and the results were compared with published data on the composition of thorium hydroxyl complexes in solution. Hydrolyzed ions with the general formula $Th[(OH)_4\ Th]_n^{4+}$ are formed at high pH (near the pH of initial precipitation). (R.V.J.)

18921 SEPARATION OF THORIUM FROM RARE EARTHS BY SORPTION ON KU-1 RESIN. A. I. Zhukov, V. N. Onosov, and N. A. Shevtsov (Ural Polytechnic Inst., USSR). Zhur. Neorg. Khim., 7: 926-9(Apr. 1962). (In Russian)

Separation of Th from rare earths by adsorption on KU-1 resin followed by selective rare-earth elution with stoichiometrically neutral 1 N ammonium chloride solution was studied. It was found that the strong bond between hydrolyzed ions and the resin and its high sorptive properties secure efficient separation of Th from the rare earths at high column loads. (R.V.J.)

18922 MASS SPECTROMETRIC STUDIES OF THE VAPOR COMPOSITION OVER ZrN, TiN, AND BN. P. A. Akishin and Yu. S. Khodeev (Moscow State Univ.). Zhur. Neorg. Khim., 7: 941-2(Apr. 1962). (In Russian)

Mass spectroscopic studies were made of the vapor over titanium and zirconium nitrides. ZrO^+ and Zr^+ were recorded in the vapor over zirconium nitride at 2000°C. The intensity ratio of 2:1 did not vary with temperature. It was assumed that ZrN decomposes at <1800°C, while TiN decomposes at <1700°C. An intense decomposition of BN was observed at <1600°C. Maximum partial pressures were equal to 10^{-8} atm at ~2100°C for ZrN, 2×10^{-8} atm at ~1800°C for TiN, and 2×10^{-7} atm at ~1600°C for BN. (R.V.J.)

18923 ACTINIUM. G. Bouissières. p.1413-46 of "Nouveau Traité de Chimie Minérale. Tome VII. Deuxième Fascicule." Paris, Masson et Cie, 1959. (In French)

A comprehensive survey is made of the properties of actinium. The nuclear and isotopic properties are first considered, and then the preparation of the metal is reviewed. The techniques used to obtain electrolytic deposits of actinium are discussed separately. The physical, chemical, and physiological properties of Ac are given, and the analytical data for this element are reviewed. The principal compounds of Ac and their properties are discussed. (J.S.R.)

18924 PROGRESS IN INTERNATIONAL RESEARCH ON THERMODYNAMIC AND TRANSPORT PROPERTIES. Second Symposium on Thermophysical Properties, January 24-26, 1962, Princeton University, Princeton, New Jersey. Joseph F. Masi and Donald H. Tsai, eds. New York, The American Society of Mechanical Engineers, 1962. 770p. $24.00.

Sixty-eight papers are included; 21 are abstracted in NSA. Two papers on statistical theory of surface tension and intermolecular potentials from scattering experiments were previously abstracted in NSA. The 45 papers not abstracted include information on thermodynamic properties of gaseous mixtures; liquid-liquid, liquid-vapor, and solid-solid systems; the H–C–N–O–K system, and an equation of state for steam; experimental investigations on various substances; computational methods for the determination of thermodynamic properties; transport properties of gaseous and liquid substances; the virial theorem; thermal conductivity measurements; measurement of viscosity and radiation; properties of ionized gases; and properties of non-Newtonian fluids. (P.C.H.)

18925 HEATS OF FORMATION OF INORGANIC FLUORINE COMPOUNDS. A SURVEY. George T. Armstrong and Leslie A. Krieger (National Bureau of Standards, Washington, D. C.). p.8-77 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

A review is given of the current state of measurements leading to heats of formation of the inorganic fluorine compounds and carbon compounds of one carbon atom per molecule. 625 references, covering the period from 1949 to mid-1961, are given. Reported values of $\Delta H_{f_{298}}$ are listed for individual compounds along with related thermo-

dynamic measurements. As a group, the binary fluorine compounds were the most thoroughly studied. Recent developments in certain phases of the calorimetry of fluorine compounds are discussed. (P.C.H.)

18926 AN EQUATION OF STATE FOR CALCULATING THE THERMODYNAMIC PROPERTIES OF HELIUM AT LOW TEMPERATURES. R. D. McCarty and R. B. Stewart (National Bureau of Standards, Washington, D. C.). p.107-17 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

A new equation of state for helium gas with six adjustable constants is presented. This relation is adequate for the representation of the PVT data and for the calculation of the entropy and enthalpy for a range of temperatures from 20 to 300°K, with pressures to 100 atm. A comparison of calculated volumes with the original data indicates an average arithmetic deviation of 0.07% and maximum deviations of 0.5%. A comparison of calculated pressures with original data indicates about the same average and maximum deviations. A temperature-entropy chart and a compressibility factor chart were prepared from values calculated by this equation of state. Values of density, enthalpy, and entropy are tabulated with temperature and pressure as independent arguments. (auth)

18927 HEAT CAPACITIES AND ENTHALPIES OF MIXING OF SOLID SOLUTIONS. THE BINARY SYSTEM TETRAMETHYLMETHANE–TETRACHLOROMETHANE. Edgar F. Westrum, Jr. and Elfreda Chang (Univ. of Michigan, Ann Arbor). p.172-7 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Heat capacities of several samples of different compositions in the system $C(CH_3)_4$–CCl_4 were studied from 5 to above 300°K for information concerning the nature of the solid solutions formed by these components, both of which are composed of globular molecules and form plastic crystals. The complex thermal properties observed and the enthalpy of mixing are discussed. (auth)

18928 MACHINE COMPUTATION OF THE THERMODYNAMIC PROPERTIES OF DICHLOROTETRAFLUOROETHANE. Nelson H. Van Wie and Robert A. Ebel (Union Carbide Nuclear Co., Oak Ridge, Tenn.). p.246-53 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Reported values for the equation of state, vapor pressure, saturated liquid density, and constant volume heat capacity for the refrigerant dichlorotetrafluoroethane were used to compute the following thermodynamic properties as functions of temperature and pressure: specific volume, heat capacity, enthalpy, and entropy. These properties are computed for the superheated vapor, both above the critical temperature and below it down to saturation temperature. In addition, the latent heat content of the saturated vapor and the saturated liquid density were calculated for given temperatures. These computations were performed on both IBM 704 and 7090 computers. Approximately 1800 digital storage locations were required. The equations used, method of solution, and computer set-up are described. Mollier, C_p– t, and compressibility curves are also presented. (auth)

18929 SOME RECENT ADVANCES IN GAS TRANSPORT THEORY. Sydney Chapman (Univ. of Alaska, College; High Altitude Observatory, Boulder, Colo.; and Univ. of Michigan, Ann Arbor). p.257-65 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Discussion is given on three topics in which recent advances have been made in thermal diffusion: dusty gases, hot gases containing multi-ionized atoms, and the effects of neutral particles in plasmas in strong magnetic fields. As regards dusty gases, recent theoretical progress concerns also the mobility of the dust and the drag on the dust particles when the gas is mixed and when there is relative diffusion in the mixture. A magnetic field reduces thermal conduction transverse to the field in an ionized gas. Any neutral particles in the gas then contribute disproportionately to thermal conduction because they are uninfluenced by the field. This has a bearing on solar prominences and on the earth's outermost atmosphere. (P.C.H.)

18930 THE LEWIS NUMBER. Richard Brokow (Lewis Research Center, Cleveland). p.271-8 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

A more general definition of Lewis number based on the theory of the thermal conductivity of gas mixtures in chemical equilibrium is presented and discussed. This applies to complex gas mixtures involving many equilibria—mixtures which cannot be described by a single diffusion coefficient. The general definition may be used to derive the effect of Lewis number on convective heat transfer, provided total pressure gradients and external force fields are negligible. When this technique is applied to stagnation-point heat transfer, results are in excellent agreement with numerical solutions of the boundary-layer equations. Lewis numbers are approximated for reactions of the type $A \rightleftharpoons nB$; it is found that Lewis number decreases as the extent of dissociation increases; the magnitude of this variation is a function of n. Rigorous calculations for the hydrogen and nitrogen dissociations, based on known intermolecular potentials confirm these trends. Incipient ionizations of hydrogen, helium, and neon are also rigorously computed; Lewis numbers are low for such systems. This is attributed to abnormally large collision cross sections for ion-atom encounters—a consequence of charge transfer. Finally, Lewis numbers for air and a hydrogen–oxygen rocket exhaust are presented. These calculations indicate that Lewis numbers for complex systems can be estimated by considering the nature of the dissociative processes. (auth)

18931 SURVEY OF RECENT WORK ON THE VISCOSITY, THERMAL CONDUCTIVITY, AND DIFFUSION OF GASES AND LIQUEFIED GASES BELOW 500°K. P. E. Liley (Purdue Univ., Lafayette, Ind.). p. 313-39 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Recent theoretical and experimental studies of the three principal transport coefficients of gases and gas mixtures in the temperature range of up to 500°K are reviewed and references are also listed for studies of these gases in the liquid phase. Summary tables are provided to enable easy access to references for the pressure and/or temperature dependence for a particular property and gas. 394 references are given. (auth)

18932 THERMODYNAMIC AND TRANSPORT PROPERTIES OF LIQUIDS. Henry Eyring, Douglas Henderson, and Taikyue Ree (Univ. of Utah, Salt Lake City). p.340-51 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Liquids apparently contain holes which are chiefly of molecular size. Such a hole confers gas-like properties on a molecule jumping into it. In addition each molecule-hole pair contributes a solid state degeneracy. With these ideas of the significant structures it was possible to develop a partition function for the liquid which gives the thermodynamic and transport properties of the liquid over the entire volume temperature range. The results of applying the theory to normal liquids such as argon and methane, molten metals such as sodium and mercury, and to molten salts such as sodium and potassium chlorides are reported. More recently quantum liquids such as ortho, para, and normal hydrogen and the corresponding kinds of deuterium were successfully investigated and the thermodynamic properties calculated. These results as well as present calculations on the transport properties of these latter substances are also reported. A discussion of how the significant structure theory is extended to water and to various solutions is also given. (auth)

18933 THE PREDICTION OF THE TRANSPORT PROPERTIES OF PURE GASEOUS AND LIQUID SUBSTANCES. Leonard I. Stiel and George Thodos (Northwestern Univ., Evanston, Ill.). p.352-65 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

A review is given of work conducted on the transport properties of individual substances and groups of substances and groups of substances existing in the gaseous and liquid states. The individual substances investigated are argon, nitrogen, hydrogen, methane, ethylene, carbon dioxide, sulfur dioxide, ammonia, and water. The information obtained from experimental data for the viscosity and thermal conductivity behavior at moderate pressures for these substances was utilized in conjunction with the Abas-zade relationship to establish the transport properties at high pressures. Reduced state correlations of the transport properties investigated for each substance were then developed. The Abas-zade relationship was verified by obtaining experimental data for ammonia at pressures up to 5000 psia. The transport properties of the monatomic and diatomic substances were correlated by use of previous results. The low pressure viscosity and thermal conductivity behavior of these groups was first established and then used with the Abas-zade relationship to develop reduced state correlations for each family for the entire range of temperature and pressure. A dimensional analysis approach was applied to the correlation of the viscosity and thermal conductivity of gases at moderate pressures with their molecular weights and critical properties. Experimental data were utilized to establish relationships for the viscosity of polar and nonpolar gases and the thermal conductivity of hydrocarbon gases. In addition, dimensional analysis and experimental data were used to relate the Lennard-Jones force constants to the critical properties of the substance. The results were compared with the corresponding experimental values and proved to be of a high degree of accuracy in establishing the transport properties of gases and liquids. (auth)

18934 VERY SHORT RANGE INTERACTIONS OF HYDROGEN ATOMS AND HELIUM ATOMS. R. A. Buckingham and D. M. Duparc (Univ. of London). p.378-85 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

The electronic energy of the system H + H in the lowest singlet and triplet states and the system He + He in the ground state was calculated by molecular orbital methods for nuclear separations in the range 0–1 amu. The validity of a polynomial expansion for the energy was investigated, along with the usefulness of Bingel's formulas. For the He + He system a two-configuration calculation was carried out, and comparison made with other results for the helium interaction. (auth)

18935 THE APPLICATION OF FREQUENCY RESPONSE ANALYSIS TO THERMAL CONDUCTIVITY MEASUREMENTS. Barry L. Tarmy (Esso Research and Engineering Co., Linden, N. J.) and Charles F. Bonilla. p.404-11 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

The use of frequency response analysis for measuring the thermal conductivity of gases was investigated. The technique consists of passing a sinusoidal current through a hot-wore cell and measuring the amplitude and phase lag of the cyclic temperature fluctuations obtained. These characteristic frequency responses are mathematically related to thermal conductivity and are relatively insensitive to wire-to-wall radiation. Consequently, the technique offers a possible alternative to absolute methods for high temperature application. An indirect electrical method for measuring these quantities was developed, along with the necessary circuitry. Data were obtained with a precision of about 2% on helium and nitrogen at atmospheric pressure at temperatures up to 380°C. The contribution of end effects on the response measurements was evaluated empirically. (auth)

18936 HEAT CONDUCTIVITY OF COMPRESSED HELIUM AT ELEVATED TEMPERATURES. P. Johannin (C.N.R.S., Bellevue, France), M. Wilson, Jr., and B. Vodar. p.418-33 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Measurements of the heat conductivity of helium in the range of pressures from 1 to 200 atmospheres and in the range of temperatures from 30 to 350°C are given. The accuracy of the data is estimated to be within 1%; however, the data is consistent to better than 0.5%. The concentric-cylinder method was used, with a gap of 0.2 mm between the cylinders and a temperature differential of 2°C. The results were correlated empirically by the use of the classical kinetic theory and the methods of statistical mechanics with the modified Buckingham exp-six potential. These methods, somewhat modified, reproduced the data within the estimated experimental accuracy. The extrapolations of the data by the use of these methods, however, do not produce the correct trend at elevated temperatures. (auth)

18937 THE THERMAL CONDUCTIVITY OF CARBON DIOXIDE IN THE CRITICAL REGION. J. V. Sengers and A. Michels (Universiteit, Amsterdam). p.434-40 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Preliminary results are given for the thermal conductivity of carbon dioxide in the critical region. In this region the tendency for convection becomes very high. A thermal conductivity cell specially designed to meet this difficulty from the outset was constructed. It is shown that the thermal conductivity coefficient possesses a pronounced maximum in the critical region. A comparison is made with the behavior of the specific heat and the viscosity. (auth)

18938 HIGH TEMPERATURE THERMAL PROPERTY MEASUREMENT TO 5000°F. David S. Neel and C. D. Pears (Southern Research Inst., Birmingham, Ala.). p.500-11 of "Progress in International Research on Thermody-

namic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

The thermal expansion, thermal conductivity, and heat capacity of several refractory materials were determined from room temperature to 5000°F or to the destruction point of the material. High temperature furnaces with helical graphite heaters were used for heating the specimens. Thermal expansion measurements were made with graphite dilatometers, thermal conductivity measurements with a miniaturized radial heat flow apparatus, and heat capacity measurements with a drop-type ice calorimeter. Specimen temperatures were measured by means of optical pyrometers and high temperature thermocouples. The thermal properties were determined for graphite, tungsten, several metallic alloys, and several carbides, nitrides, borides, and oxides. Quite often, the materials failed at temperatures below the expected melting point. The thermal property values varied considerably with temperature on most materials, and contained inflections that often could be explained by changes in structure; however, inflections that could not be anticipated were rather common. (auth)

18939 THE DETERMINATION OF THE EMITTANCE OF REFRACTORY MATERIALS TO 5000°F. C. D. Pears (Southern Research Inst., Birmingham, Ala.). p.588-98 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

The emittances of various refractory materials were determined at temperatures from 800 to 5000°F. The measurements were made by comparing the irradiance from a sample of the material to that from a black body cavity maintained at the same temperature. A thermopile-type detector was employed. Small disc-shaped specimens were heated in an inert atmosphere by placing them on a disc that was inductively heated by a flat induction coil. The specimen temperature was measured by means of surface thermocouples and an optical pyrometer. The optical pyrometer readings were corrected to true temperatures for the measured emittance with the aid of thermocouple calibration, gray body assumption, and spectral measurements. The emittances of platinum, pyrolytic graphite, tungsten, molybdenum, carbides, oxides, nitrides, and silicides were determined to their destruction temperatures. Several coatings including the W-2, siliconized finishes, chrome oxides, and other specially treated surfaces were also evaluated. The emittances of the different materials varied considerably with temperature and showed many inflections which usually could be associated with material phase changes and expansion coefficients, but which quite often could not be predicted. (auth)

18940 THE EQUATION OF STATE OF AN IONIZED GAS. Donald P. Duclos and Ali Bulent Cambel (Northwestern Univ., Evanston, Ill.). p.601-17 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

The equation of state of an ionized gas is investigated in the range of temperatures and electron densities of engineering interest. The gas is assumed to be monatomic, electrically neutral, and in thermodynamic equilibrium, but the composition of the gas is arbitrary, that is, multiple ionization of any degree is allowed. Previous work is reviewed, and the limits of validity of various theories are determined. The classical corrections to the perfect gas expressions due to electrostatic forces and the finite size of particles, as obtained from the theories of Debye and Hückel, and others, are investigated. Quantum corrections due to electron degeneracy, electron interactions, and black-body radiation are also considered. In some cases, improved expressions are derived and suitable approximations are suggested. (auth)

18941 ELECTRICAL AND THERMAL CONDUCTIVITY OF ARGON PLASMA. F. Bošnjakovic and W. Springe (Technische Hochschule, Stuttgart). p.618-25 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Working values for the electrical and thermal conductivity of argon plasma are given up to 50000°K. These values were determined by means of Schirmer, Curtiss, Hirschfelder, and Bird solutions concerning the Boltzmann equation. The theoretical values for electrical conductivity were examined by means of a cylindrical arc and sufficient agreement was found. (auth)

18942 RADIATION PROCESSES IN A PLASMA AT HIGH TEMPERATURES. Taro Kihara (Tokyo Univ.). p.656-9 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Bremsstrahlung, Cherenkov, and cyclotron radiations from free electrons in a plasma are considered. The bremsstrahlung is usually in the ultraviolet or x-ray region, and is perfectly transparent for a plasma of experimental size. Cherenkov and cyclotron radiations are in the microwave region, and hence these radiations from electrons in a plasma are not like radiations from a plasma. (auth)

18943 CHERENKOV AND CYCLOTRON RADIATIONS IN PLASMAS. Taro Kihara, Osamu Aono, and Ryo Sugihara (Tokyo Univ.). p.660-5 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Cherenkov radiation from a moving charge q in a magnetoplasma was found to be $q^2\omega_0^2/2\nu \ln(\nu^2/m^{-1}kT)$ per unit time, when the speed ν is much larger than the thermal velocity $(m^{-1}kT)^{1/2}$ of the plasma electron, ω_0 being the plasma frequency. This radiation depends neither on the absolute value nor on the direction of the magnetic field, as long as the gyration frequency ω_H is small as compared with ω_0. The cyclotron radiation from an electron moving in a plasma with a large but non-relativistic speed, $c(m^{-1}kT)^{1/2} \ll \nu^2 \ll c^2$, was calculated to be $e^2\omega_H^2\nu_\perp^2/c^3 (s+2)(2s+1)^{1/2}/3(s+1)^2$ per unit time, $s \equiv c^2/\nu^2\ \omega_0^2/\omega_H^2$. Here $-e$ is the electron charge, $\nu_\perp^2$ is the velocity component perpendicular to the magnetic field. It shows how the cyclotron radiation is shielded in plasmas. Damping of the Cherenkov radiation due to collisions of plasma electrons is also discussed. (auth)

18944 SIGNIFICANT ASPECTS OF NON-NEWTONIAN TECHNOLOGY. David G. Thomas (Cambridge Univ., Eng.). p.669-86 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

The origin of non-Newtonian flow characteristics are discussed and typical data illustrating the general scheme of classification recommended by the Society of Rheology are presented. Different approaches to the formulation of an equation of state are mentioned, and simplified flow models commonly used in engineering studies are discussed in some detail. Finally, applications of these models in the correlation of laminar and turbulent flow results in circular tubes are reviewed and limitations are noted. (P.C.H.)

18945 TRANSPORT CHARACTERISTICS OF SUSPENSIONS: APPLICATION OF DIFFERENT RHEOLOGICAL MODELS TO FLOCCULATED SUSPENSION DATA. David G. Thomas (Cambridge Univ., Eng.). p.704-17 of "Progress in International Research on Thermodynamic and Transport Properties." New York, The American Society of Mechanical Engineers, 1962.

Correlation of the turbulent transport characteristics of shear-rate thinning non-Newtonian materials requires results of laminar-flow studies for a wide range of conditions. This information is usually incorporated in the correlations using a variety of different rheological models. Little data are available on the factors which affect the magnitude of the coefficients in these models. It is shown that the coefficients in four commonly-used models (the power law, the Bingham plastic, the Crowley-Kitzes, and the Eyring) were simple functions of the concentration and particle size for suspensions of symmetrically-shaped particles. The range of variables included concentrations from 0.033 to 0.27 volume fraction solids in water and a particle size range of 0.4 to 2.9 microns. Materials tested included ThO_2, kaolin, TiO_2, UO_2, and U_3O_8. Concurrent studies showed that these laminar physical properties were suitable for correlating turbulent flow data in tubes from 0.124- to 3.97-in. inside diameter. (auth)

Radiation Chemistry and Radiochemistry

18946 (GCM/UK/24) THEORETICAL WORK ON THE RADIATION INDUCED REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE, AND COMPARISONS WITH EXPERIMENTAL RESULTS. H. A. Jones (General Electric Co., Ltd. Telecommunications and Engineering Research Labs., Wembley, England). [1962]. 34p.

Presented at the Cockcroft/Libby Conference on Gas Coolant Compatibility, Harwell, Berks, Eng., April 1962.

Data obtained in sealed bulb experiments on the radiation-induced reaction between CO_2 and graphite are compared with results of theoretical work. The comparison indicates that the theory is reasonably consistent with the experimental results. Data and a description of the theoretical work are included. (J.R.D.)

18947 (NYO-9217) THE EFFECT OF ELECTRON IRRADIATION PRIOR TO REACTION OF THE ACTIVITY OF A SEMICONDUCTOR CATALYST. Final Report, February 1, 1959 to September 30, 1961. E. A. Mason, R. C. Reid, and N. J. Stevens (Massachusetts Inst. of Tech., Cambridge). Sept. 1961. Contract AT(30-1)-2329. 259p.

The effects of high energy electron irradiation on the catalyst activity, surface area, and electrical properties of cuprous oxide were investigated. Initially, the kinetics of the oxidation of carbon monoxide on cuprous oxide at 1 atmosphere and near 150°C was studied. These experiments were conducted isothermally with initial carbon monoxide mole fractions from 0.20 to 0.60. The reaction was found to be second order with respect to both oxygen and carbon monoxide. The reaction rate was especially sensitive to temperature and values of the apparent activation energy varied widely on the four catalyst specimens tested ranging from 32.8 ± 1.4 to 75.6 ± 4.1 k-cal/g-mole. A mechanism involving the interaction between two "carbonate-type complexes" to form carbon dioxide is proposed as the rate controlling step in interpreting the rate expression obtained. The high over-all order results from the fact that the concentration of each "carbonate complex" depends on the partial pressures of both oxygen and carbon monoxide. Irradiation of the catalyst prior to reaction was carried out using 3.5 Mev electrons from a Van de Graaf generator. The effect was to decrease the catalytic activity of cuprous oxide for the carbon monoxide oxidation by 50% as a result of 300 seconds of bombardment at a flux of 3.12×10^{12} electrons/cm^2-sec. The apparent activation energy remained unaffected by the high energy radiation with the entire decrease in the reaction rate constant being a result of a reduction of the pre-exponential factor. None of the results indicated a change in the reaction mechanism or in the rate expression describing the kinetics. The electrical conductivity, carrier concentration, and mobility of cuprous oxide were also reduced by electron irradiation. The major changes were attributed to an increase in the concentration of the copper and oxygen vacancies which regulate the electrical properties. Although the amount of radiation used in this work displaced only an extremely small fraction of the atoms present in cuprous oxide, the defect concentration was considerably altered. The solid state damage produced indicates the importance of the defect nature of a semiconductor in affecting physical and catalytic properties of the material. Contrary to the effect of irradiation on the catalytic and electrical properties of cuprous oxide, an increase in the measured surface area occurred as a result of bombardment. The B.E.T. values were 30 to 40% larger after irradiation owing principally to an increase in surface roughness. Despite the large change in surface area, the effect of the surface conditions are believed to play little part in accounting for the decrease in activity. (auth)

18948 (UCRL-9983) RADIATION CHEMISTRY OF ISOPROPYL COMPOUNDS (thesis). Michael A. Sweeney (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 8, 1962. Contract W-7405-eng-48. 133p.

Purified, degassed samples of eight organic liquids, isopropyl chloride, isopropyl alcohol, isopropyl benzene, isobutyronitrile, isobutyric acid, isovaleric acid, methyl isobutyl ketone, and isopropyl acetate, were irradiated with 48-Mev helium ions and with gamma rays from a Co^{60} source. The volatile radiolysis products were separated and analyzed. Formation of these products is explained by free-radical reactions and by molecular rearrangements of the type $i\text{-}C_3H_7X = HX + C_3H_6$. The differences in respective product yields between the two types of radiation were in accord with the proposed decomposition patterns. Products considered to be formed by radical-radical reactions were found in larger yield in the more densely ionizing helium-ion irradiations; Co^{60} irradiations formed larger amounts of products considered to result from radical-molecule reactions. Molecular rearrangement to form HX plus propylene occurred in these radiolyses. For several of the compounds studied it was a major source of radiolytic product. The extent of rearrangement in any given compound depends on the electronic nature of the molecule and on the mechanism by which the rearrangement occurs. (auth)

18949 STUDIES ON THE SONIC DEGRADATION OF DEOXYRIBONUCLEIC ACID. David Freifelder and Peter F. Davison (Massachusetts Inst. of Tech., Cambridge). Biophys. J., 2: 235-47(May 1962).

DNA was partially degraded by x rays, DNAase, and sonic irradiation. The molecular weight distributions were calculated from sedimentation velocity studies on the resulting preparations. Comparison with the theoretical curve derived by Montroll and Simha showed that the first two degradative methods act grossly at random, whereas sonication is a non-random process resulting

in the preferential halving of the DNA molecules in solution. (auth)

18950 EFFECTS OF GAMMA RADIATION ON POLYMER IN SOLUTION. I. POLY(VINYL ACETATE). Ichiro Sakurada and Yoshito Ikada (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 1-15(Mar. 1962). (In English)

Gamma irradiation of polyvinyl acetate (PVAc) in various organic solvents at a concentration of 10 wt %, resulted in crosslinking in methanol and benzene, but in many other organic solvents degradation occurred predominantly. As the solvents became poorer, crosslinking was promoted at low concentrations but retarded at high concentrations of the polymer. The most optimum concentration for crosslinking of the polymer in methanol solution was about 20%, where it was found that degradation hardly ever occurred. When PVAc was irradiated in methanol–organic solvent mixtures, the rate of crosslinking was retarded as the solubility of the polymer in solution was raised. However, in methanol–water mixtures, no correlation was observed between the radioinduced changes and the solubility, but the rate of crosslinking increased monotonically with increasing water content in the mixtures, which may indicate that water is a very effective solvent for crosslinking. The radioinduced changes were very slight during irradiation at −50°C but relatively large at 70°C. The minimum doses needed for gelation in the 10% benzene solutions were inversely proportional to the degree of polymerization of the initial polymer. It was confirmed that the density of crosslinked units was proportional to the radiation dose and that crosslinks were formed not only from the main chain radicals (not end radicals), but also from the side chain radicals. (auth)

18951 EFFECTS OF GAMMA RADIATION ON POLYMER IN SOLUTION. III. POLY(VINYL ALCOHOL) PARTIALLY ACETALIZED WITH GLYOXYLIC ACID. Ichiro Sakurada and Yoshito Ikada (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 25-35(Mar. 1962). (In English)

When polyvinyl alcohol (PVA), partially acetalized with glyoxylic acid (PVAG), was irradiated in air-free aqueous solution without added salt, gelation occurred more readily and the critical concentration for gel formation was reduced, as the degree of expansion of PVAG was increased. However, when NaCl was added to the solutions before irradiation so as to make the expansion of all PVAGs equal to that of parent PVA, the critical concentrations were practically identical to the value of parent PVA independently of their carboxyl group contents. Further addition of the salt to solutions led to the increase in gelation dose. It was concluded from these results that the critical concentration corresponds to the concentration at which the overlap of a polymer with other ones commences. Based on this conclusion, the expansion of the polymer molecule was calculated and compared with that calculated from the viscosity data. These two showed a good agreement. When PVAG was irradiated in aerated aqueous solution without added salt, degradation was promoted with increasing carboxyl group content, while in the case of solutions containing added salts degradation occurred scarcely. (auth)

18952 EFFECTS OF GAMMA IRRADIATION ON DIPHOSPHOPYRIDINE NUCLEOTIDE. Shozo Tanaka, Hiroyuki Hatano, and Shigetake Ganno (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 36-41(Mar. 1962). (In English)

A chemical effect of small doses of γ irradiation on reduced diphosphopyridine nucleotide in aqueous solutions was found. The effect may be due to oxidation of the DPNH by an indirect action of γ irradiation. Electron spin resonance spectra of irradiated DPN and of nicotine amide, a constituent of DPN, were investigated and formation of free radicals from irradiated coenzymes was proved. A reaction mechanism is proposed. (auth)

18953 ELECTRON SPIN RESONANCE OF X-RAY-IRRADIATED SINGLE CRYSTALS OF dl-ALANINE HYDROCHLORIDE. W. C. Lin and C. A. McDowell (Univ. of British Columbia, Vancouver). Can. J. Chem., 40: 1060-3(June 1962).

The electron spin resonance of an x-irradiated single crystal of dl-alanine hydrochloride indicates that the radical formed is probably the same as that produced by x and γ irradiation of alanine. The components of the hyperfine interaction tensor for the radical were evaluated. (auth)

18954 THE PHOTOIONIZATION OF NITROGEN DIOXIDE. D. C. Frost, D. Mak, and C. A. McDowell (Univ. of British Columbia, Vancouver). Can. J. Chem., 40: 1064-7(June 1962).

The ionization of nitrogen dioxide by photons was studied using a photoionization mass spectrometric technique and also by the ordinary electron impact method. The photoionization results show a large variation in the relative ionization efficiency within the energy range 9–14 ev, and help to explain the differences between previously reported values for the first ionization potential of the compound. The photoionization efficiency curve indicates the first ionization potential to lie at 9.8 ev and inner ionization potentials to lie at about 11.1 and 12.7 ev. The electron impact ionization efficiency curve for the NO_2^+ ion exhibits a low ion intensity near the threshold. This confirms the viewpoint that previous determinations of the first ionization potential have employed threshold energy measuring techniques not properly suited for the type of molecule such as nitrogen dioxide which radically changes symmetry on ionization. (auth)

18955 TRITIUM RELEASE FROM THE NEUTRON-IRRADIATED LITHIUM-DOPED NICKEL OXIDE. Constanţa Mănţescu and T. Costea (Inst. of Atomic Physics, Bucharest). Can. J. Chem., 40: 1232-3(June 1962).

Lithium-doped nickel oxide was obtained by sintering reagent grade nickel oxide and lithium carbonate at 800°C to obtain $5Li_2O:100NiO$. The powder obtained was then heated under high vacuum for 3 hr at 200°C, and then irradiated. It was observed that the bulk of the activity was trapped in the crystalline lattice of the lithium-doped nickel oxide, the released activity during the irradiation being under 1% of the total activity. The release process requires an activation energy, the tritium or the tritiated compounds being trapped in the crystalline lattice. A second observation indicated that only tritium oxide was produced—the only volatile compound of tritium at room temperature under vacuo conditions, but condensable at the liquid nitrogen temperature. At 100°C, the samples release free tritium but, at higher temperatures, only tritium oxide is released. Discussion is given on whether the tritium production reaction takes place in the irradiation period or in the thermal period. (P.C.H.)

18956 THE LOW-TEMPERATURE VARIATION OF THE ELECTRON PARAMAGNETIC RESONANCE SIGNAL OF A MONOCRYSTAL OF GLYCOCOLL IRRADIATED WITH X RAYS (IN THE 9000 MHz BAND). Andre Bottreau (Faculté des Sciences, Bordeaux). Compt. rend., 254: 1245-6(Feb. 12, 1962). (In French)

The variations of the hyperfine structure of a glycocoll monocrystal irradiated with x rays were studied as a function of the crystal orientation and the temperature. A spe-

cial attempt was made to determine the temperature domain where the spectral variations occur. (tr-auth)

18957 A MOLECULAR REARRANGEMENT OF BENZOIC ACID UNDER THE EFFECT OF γ RADIATION OF COBALT-60. Jean-Pierre Adloff and Monique Ricq (Centre de Recherches Nucléaires, Strasbourg). Compt. rend., 254: 1417-19(Feb. 19, 1962). (In French)

Under the effect of Co^{60} γ radiation, benzoic acid labeled on the acid radical is transformed into benzoic acid labeled on the nucleus, with a radiochemical yield G = 0.01. (tr-auth)

18958 CHARGE STATES OF MOLECULAR FRAGMENTS FROM CCl_3Br FOLLOWING NUCLEAR DECAY OF Br^{80m} AND Br^{82}. S. Wexler (Argonne National Lab., Ill.). J. Chem. Phys., 36: 1992-8(Apr. 15, 1962).

A comparison of the positive ionic fragments from dissociation of trichlorobrommethane by β^-, γ decay of 35.9-hr Br^{82} and from isomeric transition of 4.4-hr Br^{80m} was made by mass spectrometric techniques. Virtually all the products following beta decay are singly charged, while distributions of multiply charged atomic species dominate the fragmentation pattern after the isomeric transition. The results indicate that negative beta decay affects the molecule rather mildly, while the effect is violent following isomeric transition with internal conversion. In the latter mode of nuclear decay the molecule apparently explodes as a result of multicenter Coulombic repulsion. (auth)

18959 ELECTRON SPIN RESONANCE OF IRRADIATED SINGLE CRYSTALS OF ALANINES: HINDERED ROTATION OF THE METHYL GROUP IN A FREE RADICAL. Ichiro Miyagawa and Koichi Itoh (Tokyo Univ.). J. Chem. Phys., 36: 2157-63(Apr. 15, 1962).

Electron spin resonance absorption of irradiated single crystals of alanines was observed at 9 kMc/sec. dl-Alanine and l-alanine showed the same absorption pattern. When treated with heavy water, l-alanine gave the same hyperfine structure but showed a considerably sharper linewidth. A notable dependence on temperature of the absorption was observed in the range from 110 to 210°K. It was concluded that the reorientation of the methyl group of the radical $H_2\dot{C}CHR$ is quenched at low temperature. The life time τ of the reorientation was estimated from the absorption pattern, using a modified Bloch equation. The classical theory of rate processes was applied to analyze the relation between τ and temperature. The potential barrier and the frequency factor for l-alanine were found to be 3.6 ± 0.2 kcal/mole and $(10 \pm 4) \times 10^{12}$ sec^{-1}, respectively. The same values were obtained for dl-alanine, within experimental error. The direction of each C–H bond of the methyl group was determined by analyzing the hyperfine constant for 77°K. It was also shown that some atoms in the parent molecule in the crystal shift considerably on irradiation. (auth)

18960 ENERGY TRANSFER IN IRRADIATED ALKYL DISULFIDES. Frank K. Truby (Sandia Corp., Albuquerque, N. Mex.). J. Chem. Phys., 36: 2227-9(Apr. 15, 1962).

An electron spin resonance study was made on a series of gamma-irradiated n-alkyl disulfides to determine the ability of energy imparted randomly to such molecules to be localized at the sulfur. The compounds studied were methyl, amyl, octyl, and octadecyl disulfide. Results showed that all of the compounds contain unpaired electrons localized at the sulfur. The energy imparted to the alkyl disulfides irradiated at –196°C in the ball form appear to migrate down the carbon chain in a manner observed for a $-CH_2-$ chain. For octadecyl disulfide in the ball form, it is apparent that some C–H breakage occurs before localization can take place at the disulfide link. In the case of slowly crystallized samples, significant C–H breakage is noted for five or more carbons in the alkyl group, indicating that the crystallographic configuration as well as chain length affects the ability of the energy to be localized at the disulfide link. (N.W.R.)

18961 DISAPPEARANCE OF TRAPPED HYDROGEN ATOMS IN GAMMA-IRRADIATED ICE. John M. Flournoy, Lillian H. Baum, and Seymour Siegel (Aerojet-General Corp., Azusa, Calif.). J. Chem. Phys., 36: 2229-30(Apr. 15, 1962).

When ice is subjected to gamma-irradiation at 4.2°K, H and OH radicals are formed and are stabilized in approximately equivalent amounts. When the system is warmed to 77°K, all of the H and a portion of the OH disappear. The results of kinetic observations of the disappearance of H in irradiated ice at 4.2 to 77°K using electron spin resonance techniques are described. It is thought that the kinetic behavior may be due to intra-spur reactions, rather than isotropic processes. This is supported by the fact that the fractional rate of disappearance of H during continuous warming was found to be independent of the initial concentration. (N.W.R.)

18962 CHEMICAL VALENCE STUDIES IN NUCLEAR DECAY. THE TIN–ANTIMONY SYSTEM. T. Andersen and A. B. Knutsen (Univ. of Aarhus, Denmark). J. Inorg. & Nuclear Chem., 23: 191-8(Dec. 1961). (In English)

The distribution of antimony between the trivalent and the pentavalent states was investigated in antimony (V-IV-III) compounds after thermal neutron irradiation or after β-decay in tin(IV) compounds. Antimony(III) compounds have 99% retention, antimony(V) compounds 70-81%. About 77% antimony(V) is formed in potassium and ammonium hexachlorostannate after β-decay. The increase in retention after annealing of antimony(V) compounds shows plateaus, which are temperature dependent for potassium antimonate, but temperature independent for potassium hexachloroantimonate. (auth)

18963 MONOMER REACTIVITIES IN RADIATION-INDUCED GRAFT COPOLYMERIZATION. PART II. GRAFT COPOLYMERIZATION TO TEFLON. George Odian, Terese Acker, Albert Rossi, and Elliot Ratchik (Radiation Applications Inc., Long Island City, N. Y.). J. Polymer Sci., 57: 661-7(Mar. 1962).

Gamma radioinduced surface graft copolymerizations of styrene–acrylonitrile and styrene–methyl acrylate to Teflon were studied. It was observed that the compositions of the various grafted copolymers are richer in the more polar monomer than would be predicted from the Lewis-Mayo copolymer composition equation. These results were interpreted in terms of a preferential solvation of the relatively immobile growing graft polymer free radicals by the polar monomers. (auth)

18964 POLYMERIZATION IN THE CRYSTALLINE STATE. II. ALKALI ACRYLATES AND METHACRYLATES. H. Morawetz and I. D. Rubin (Polytechnic Inst., Brooklyn). J. Polymer Sci., 57: 669-86(Mar. 1962).

Alkali acrylates and methacrylates were irradiated with gamma rays from a Co^{60} source at –78°C and their subsequent polymerization was studied in vacuo in the temperature range 0 to 155°C. Potassium acrylate proved to be the most rapidly polymerizing solid monomer studied to date; it reacted at 0°C faster than the lithium salt at 101°C or the sodium salt at 120°C. The reaction rate of the acrylates decayed rapidly at low polymer yields which were, for long polymerization times, linear in the logarithm of time. The activation energy for the polymerization of potassium acry-

late was 16.7 kcal/mole. Sodium methacrylate was more reactive than potassium methacrylate; the lithium salt of methacrylic acid was entirely inert. The sodium methacrylate polymerization had an initial accelerating phase. Studies of x-ray diffraction of the polymerizing potassium acrylate showed only minor changes in the diffraction pattern of the monomer, the size of the unit cell remaining almost unchanged. Poly(potassium acrylate) produced in the solid state showed four diffuse diffraction rings which were not observed in samples prepared from poly(acrylic acid) obtained by polymerizing a benzene solution of the monomer. The pronounced difference in the characteristics of the polymerization process of different salts of the same monomeric anion pointed to a control of the reaction by the geometry of the crystal lattice. The evidence suggests that the polymer lies in an amorphous phase but that the reactive ends of growing chains are anchored in the monomer lattice. Electron spin resonance spectra are similar for irradiated potassium acrylate and sodium methacrylate, but the potassium acrylate spectrum changes gradually from a three-peak to a single-peak structure when the sample is heated to 100°C, while the other two salts have spectra which are not affected by a similar heating cycle. The absence of the characteristic ESR spectrum of polymethacrylate radicals in irradiated sodium methacrylate suggests that under the experimental conditions used few of the primary radicals were able to initiate chains. A five-peak ESR spectrum was observed in irradiated sodium acrylate. (auth)

18965 POLYMERIZATION IN THE CRYSTALLINE STATE. III. METHACRYLIC ACID AND BUTADIENE-1-CARBOXYLIC ACID. H. Morawetz and I. D. Rubin (Polytechnic Inst., Brooklyn). J. Polymer Sci., 57: 687-92 (Mar. 1962).

Methacrylic acid polymerized in the solid state leads to a much less syndiotactic polymer than when polymerized in the liquid state. This is taken as additional evidence for the importance of the geometry of the monomer crystal lattice in solid state polymerization. Butadiene-1-carboxylic acid polymerizes spontaneously in the solid state to a cross-linked product, while the sodium, potassium, and barium salts of this acid are stable and polymerize very little, even on gamma irradiation. (auth)

18966 EFFECT OF TEMPERATURE ON THE GRAFTING OF STYRENE ON FILMS OF POLYTETRAFLUOROETHYLENE AND POLYVINYL CHLORIDE BY A DIRECT RADIOCHEMICAL METHOD. Adolphe Chapiro and Akira Matsumoto (C.N.R.S., Bellevue, France). J. Polymer Sci., 57: 743-61(Mar. 1962). (In French)

Direct radiochemical grafting of styrene on films of tetrafluoroethylene was studied at 40 and 60°C. At 40° the reaction shows kinetic characteristics similar to those observed at 19°. Above a given critical intensity, the grafting no longer proceeds in the mass, but is limited to the surface of the film. The value of this critical intensity is 6–8 rads/sec at 40°, while at 19° it is 1.0 rad/sec. At 60° the critical intensity is higher for the highest intensity examined, namely 35.1 rads/sec. The conversion curves obtained for intensities lower than the critical value indicate an autoacceleration. By representing these curves on a logarithmic scale, straight lines are obtained with a slope of 1.5–1.6 at 40° and 1.0–1.3 at 60°. At 19° the slopes of the corresponding straight lines varied from 2.5 to 3.2; this slope, which indicates the exponent of the time in the equation $C = Kt^{\beta}$ is called autoacceleration coefficient. The shift of the critical intensity to higher values, when the temperature increases, is interpreted as an increase of diffusion rate of the monomer; at 60° this last no longer determines the reaction kinetics in the experimental conditions. On the other hand, it is suggested that the decrease is due to a decrease of the contribution of the gel effect, on account of the increased mobility of the growing chains. Nevertheless, the exponent α of the intensity in the relation $V = KI^{\alpha}$, which is equal to 0.5–0.55 at 19°, varies from 0.68 at 40° to 0.70–0.72 at 60°C; this indicates that in spite of the linear form of the conversion curves at 60°C, the reaction does not become stationary. The radiochemical grafting of styrene on polyvinyl chloride was studied at 60°C. Contrarily to the reaction examined previously at 20° this reaction is not controlled by the monomer diffusion rate, and the kinetics of grafting are normal. The conversion curves are practically linear and the reaction rate is proportional to the square root of the intensity. Some curvature in the direction of the abcissa axis nevertheless exists for the conversion curves at low intensities. It may result either from a nonhomogeneous monomer diffusion or from a radiochemical protection of polyvinyl chloride by the phenyl rings of the grafted styrene. (auth)

18967 KINETICS OF THE γ-RADIATION-INDUCED POLYMERIZATION OF ETHYLENE. Richard H. Wiley (Univ. of Louisville, Ky.), N. T. Lipscomb, F. J. Johnston, and J. E. Guillet. J. Polymer Sci., 57: 867-79(Mar. 1962).

Studies of the rates of γ radioinduced polymerization of ethylene in the gas phase at 22°C, 40–70 atm and 380000 r/hr showed that the rate expressions show a good correlation with the relations expected from kinetic considerations if the density is used to express the ethylene concentrations. In this range of temperature and pressure, the density, pressure, and fugacity relations for ethylene differ significantly from those at the elevated pressures which were used in previous rate studies. Use of fugacities in the rate expression log (rate) = a + b log x, where x = p, f, or d, gives a value of 10.4 for the b term; use of pressure gives a value of 5.0; and use of density gives a value of 2.4. This last value is closest to that predicted (2.0) from a kinetic analysis which takes into consideration an initiation step dependent on monomer concentration and termination by primary radicals. Studies of the liquid-phase polymerization over the temperature range of 5 to −40°C give an activation energy of 4.4 ± 1.8/kcal/mole. Infrared analysis of the product indicates that short-chain branching is much less (0–1.2 vs 2–3 branches per 100 carbon atoms) than for polyethylenes prepared at higher temperatures. Relations between solution and melt viscosities indicate a high degree of long-chain branching in the polymer. (auth)

18968 GAS-EXPOSURE LABELING OF ORGANICS WITH TRITIUM. Marvin L. Whisman and Barton H. Eccleston (Bureau of Mines, Bartlesville, Okla.). Nucleonics, 20: No. 6, 98-102(June 1962).

Methods for labeling organic compounds with tritium are reviewed. Particular emphasis is placed on the modifications of the basic Wilzbach gas-exposure labeling process (long-time, room-temperature exposure of tritium gas and the compound to be labeled). The modifications are primarily concerned with the removal of unwanted tritium-labeled byproducts formed during the process. Purification processes used in the modified process are discussed. A comparison is given of the common labeling methods: synthesis, recoil labeling, and gas-exposure or a modification of the gas-exposure technique. A table is presented of tritium-labeled materials and the labeling technique used for the compound. (N.W.R.)

18969 THE REACTIONS OF RECOIL TRITIUM WITH ANILIDES. Jiro Okamoto and Gen-ichi Tsuchihashi (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 10: 414-19(Dec. 1961). (In Japanese)

The distribution of tritium in some tritiated anilides (acetanilide, propionanilide, n-butylanilide, iso-butylanilide) which were produced by irradiation of mixed powder of anilides and lithium carbonate, were investigated. The tritium contents of the ortho-, meta-, and para-positions in the anilides were obtained by the activity measurement of some derivatives. The reactivities of ortho-position for tritium decreases in the order acetanilide, propionanilide, n-butylanilide, iso-butylanilide, perhaps because of steric interference of alkyl groups. The contents of incorporated tritium in alkyl groups were 13.2%, 31.7%, 31.1%, and 45.4%, for acetanilide, propionanilide, n-butylanilide, iso-butylanilide, respectively. (auth)

18970 NEUTRON IRRADIATION OF ORGANIC COMPOUNDS CONTAINING A NITROGEN ATOM. Enzo Tachikawa and Gen-ichi Tsuchihashi (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 10: 420-5 (Dec. 1961). (In Japanese)

The formation of re-entry or synthesis products during the neutron irradiation of acetoxime or acetaldoxime was carefully studied paying particular attention to the relationship between the yields of these products. It was found that the yields of re-entry and synthesis products are proportional to the number of carbon and hydrogen atoms in the mother compounds, respectively. From these results, it would be concluded that the main process forming the re-entry products is a knock-on reaction of C^{12} by C^{14} and that giving the synthesis products is a single methylation of the mother compounds by C^{14}-methyl or C^{14}-methylene radical. Furthermore, it was identified that in the oxamide irradiated, the yields of C^{14}-malonamide compared to that of C^{14}-oxamide was very small, i.e., 1/14. The results are also explained by the above processes. (auth)

18971 SEPARATION AND PURIFICATION OF RADIOACTIVE ZIRCONIUM RADIOISOTOPES. E. A. Moskal'kova, D. K. Popov, Yu. M. Tolmachev. Radiokhim. Analiz Produktov Deleniya, Akad. Nauk S.S.S.R., Radievyi Inst., Sbornik Statei, 58-62(1960).

LaF_3 is twice precipitated from the solution to be analyzed, which contains the carrier Zr and the 44% HF(3ml). The precipitate is separated, and the $BaZrF_6$ is precipitated from the solution by means of saturated $Ba(NO_3)_2$ solution. The precipitate is centrifuged, washed with 0.5% HF and water, and dissolved by successive addition of 5 ml of 5%H_3BO_3 solution, 10 ml of water, and 3 ml of concentrated HNO_3. $BaSO_4$ is precipitated by means of 5% H_2SO_4 from the solution heated to boiling. The solution with the precipitate is heated for 10 min, then cooled down, and the $BaSO_4$ precipitate is separated out and washed out by means of 0.1% H_2SO_4. The $Zr(OH)_4$ is precipitated from the filtrate by a 30% KOH solution. The precipitate is centrifuged, washed by means of 1% KNO_3 solution, and dissolved in a minimum quantity of concentrated HCl. The $Zr(OH)_4$ is precipitated once more, and after its dissolution in concentrated HCl, the solution is diluted to 1 N concentration of HCl. The phenyl arsonate of Zr(I) is precipitated out of the solution obtained by adding 5 ml of the 10% solution of phenyl arsonic acid to 6 N HCl. The sediment (I) is separated out, washed out by means of 1 N HCl (containing 0.1% phenyl arsonic acid), and treated with 5 ml of 10% NaOH solution. The $Zr(OH)_4$ precipitated is centrifuged, washed by means of 0.5% NaOH solution, dissolved in concentrated HCl, and the separation of (I) and its conversion $Zr(OH)_4$ are repeated. The latter is dissolved in 6 N HNO_3 by adding 3 ml of 44% HF in 5 mg La. The LaF_3 precipitated is separated and washed out in 0.5% HF. Subsequently, the $BaZrF_6$ is twice precipitated, and treated as previously described. The $Zr(OH)_4$ is dissolved in concentrated HCl, and the precipitation and treatment of (I) by conversion to $Zr(OH)_4$ is repeated. The latter is reprecipitated by means of the 10% NH_4OH solution, centrifuged, annealed to ZrO_2 (1000-1100°C), and its activity measured. The chemical yield is 65 to 70%. The factor of purification from Nb is $\sim 3.0 \cdot 10^5$, that from the total of fission fragments is $\sim 10^7$. The method described for precipitating $BaZrF_6$ is suited for determining the activity of Ba. In this case, the previous precipitation of LaF_3 is omitted to prevent a capture of radioactive Ba from the solution by LaF_3. (OTS)

18972 DE POLYMERISATIE VAN INDEEN GEINITIEERD DOOR PEROXIDEN EN GAMMASTRALEN. (The Polymerization of Indene Initiated by Peroxides and Gamma Radiation). N. Luijendijk. Thesis, Amsterdam, Universiteit, 1961. 152p.

Indene was polymerized at 50 and 80°C with dibenzoylperoxide and at 50°C with bis(2,4-dichlorobenzoyl)-peroxide in the absence of oxygen. The polymerization rate was determined by a dilatometric method. At 20°C pure indene and solutions of indene in CCl_4, CH_3OH, and toluene were polymerized by means of Co^{60} gamma radiation. The G-values were determined with the stable radical diphenylpicrylhydrazyl. An explanation is given for the fact that the polymer chains of indene are short in comparison with styrene polymers. (NPO)

18973 ACTIONS CHIMIQUES ET BIOLOGIQUES DES RADIATIONS. (Chemical and Biological Action of Radiation). Troisième Série. Paris, Masson et Cie, 1958. 222p.

Three articles reviewing the effects of radiation on organic materials are presented. The topics discussed are radiolysis of organic liquids, radioinduced polymerization, and effects of high-energy radiation on polymers. Separate abstracts of these articles were prepared. (J.S.R.)

18974 RADIOLYSIS OF ORGANIC LIQUIDS. Milton Burton (Univ. of Notre Dame, Ind.). p.1-61 of "Actions Chimiques et Biologiques des Radiations." Paris, Masson et Cie, 1958. (In French)

The theory of radiolysis of organic liquids with respect to the physical and chemical effects is discussed. Observations of the radiolysis of hydrocarbons, halogenides, alcohols, acids, esters, ethers, aldehydes, cetones, and various mixtures are presented and interpreted. (J.S.R.)

18975 POLYMERIZATION INITIATION BY IONIZATION RADIATION. Adolphe Chapiro and Michel Magat (Faculté des Sciences, Paris). p.63-140 of "Actions Chimiques et Biologiques des Radiations." Paris, Masson et Cie, 1958. (In French)

After a brief review of the principle elements of the theory of polymerization, the general characteristics of radiochemical polymerization are studied. The experimental data on the polymerization of pure monomers in homogenous in nonhomogenous media are examined in detail. The case of the polymerization of monomers in solution is then considered. A method for the synthesis of grafted copolymers by radiochemical methods is described. It is shown how it is possible to calculate reactors for industrial polymerization. (tr-auth)

18976 EFFECTS OF HIGH-ENERGY RADIATION ON POLYMERS. A. Charlesby (Royal Military Coll. of Science, Shrivenham, Wilts, Eng.). p.141-207 of "Actions Chimiques et Biologiques des Radiations." Paris, Masson et Cie, 1958. (In French)

The principal characteristics of polymers with linear chains are reviewed, and the mathematical theory of the

transformation of these linear chains into three-dimensional lattices is given. The changes in the properties which are observed when such a lattice is produced by irradiation are analyzed. In addition to reticulation, specific chemical transformations can be produced in long-chain polymers; this group of transformations is described. The modifications to the crystalline state followed by x-ray diffraction and density changes are reviewed. The mathematical theory of the degradation of long-chain polymers is described, and the theory is applied to some rare degradations which are studied in detail. The energy requirements for modification of the chemical bonding is considered, and results in the realm of radiation protection are reviewed. (J.S.R.)

Raw Materials and Feed Materials

18977 THE FLOTATION OF RADIOACTIVE MATERIALS. D. E. Light, G. A. Freitag, G. B. Hudson, and E. J. Nurse. Can. Mining Met. Bull., 55: 30-4(Jan. 1962).

The amount of U_3O_8 recovered from brannerite, pitchblende, allanite, uranothorite, uraninite, euxenite, fergusonite, pyrochlore, betafite, and thucolite ores as a function of various collecting reagents including oleic acid, Acintol C, D, FA1, and FA2, cottonseed oil, Cyanamid 765, R-801, and R-825, Emersol 300, Indusoil L-5, linseed oil, Neofat 42-12 and 140, Amac 1120, and Duomeen 12 is determined. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

18978 FRENCH PROGRESS IN THE REALM OF PROCESSING OF URANIUM ORES. J. E. Léger. Energie nucléaire, 4: 16-23(Jan.-Feb. 1962). (In French)

As a result of the development of its uranium industry in the last few years, France is the fourth largest producer of uranium. The three uranium ore processing plants in metropolitan France and the one constructed in Gabon are described, and the processes used are indicated. The chemical problems to be solved in ore processing are briefly reviewed. (J.S.R.)

18979 α-UO_3: ITS PREPARATION AND THERMAL STABILITY. E. H. P. Cordfunke (Reactor Center of the Netherlands, Petten (N.H.)). J. Inorg. & Nuclear Chem., 23: 285-6(Dec. 1961). (In English)

A simple method for the preparation of α-UO_3 starting from $UO_2 \cdot 2H_2O$ is described. The thermal stability of this phase is discussed. (auth)

18980 PROCESS FOR THE PRODUCTION OF FLUORINE COMPOUNDS OF URANIUM. Albert Level and Bernard Couchet-Muchy (to Commissariat a l'Energie Atomique). British Patent 897,268. May 23, 1962.

A dry process is outlined for producing a fluorine derivative of U, from metal uranates, which may be used in the preparation of UF_6 of U metal. The process comprises subjecting the uranate to the simultaneous or successive actions of a reducing agent and HF to produce a compound with the formula $UF_4 \cdot nRF_v$, where R is the metal of the uranate and v is its valence. The reduction and fluorination steps are preferably carried out at 250 to 850 and 500 to 600°C, respectively. The process may be carried out in fixed or fluidized beds of solid uranate. Examples of the process are given in which Na, Ca, and Mg uranates were converted into U fluorides. (D.L.C.)

18981 METHOD FOR PREPARATION OF SPHERICAL UO_4. J. F. Gregory, Jr. and R. P. Levey, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,037,840. June 5, 1962.

A method is given for continuously precipitating uranium peroxide in the form of spherical particles. Seed crystals are formed in a first reaction zone by introducing an acidified aqueous uranyl nitrate solution and an aqueous hydrogen peroxide solution at a ratio of 5 to 20 per cent of the stoichiometric amount required for complete precipitation. After a mean residence time of 2 to 5 minutes in the first reaction zone, the resulting mixture is introduced into a second reaction zone, together with a large excess of hydrogen peroxide solution. The resulting UO_4 is rapidly separated from the mother liquor after an over-all residence time of 5 to 11 minutes. The first reaction is maintained at a temperature of 85 to 90°C and the second zone above 50°C. Additional reaction zones may be employed for further crystal growth. The UO_4 is converted to U_3O_8 or UO_2 by heating in air or hydrogen atmosphere. This method is particularly useful for the preparation of spherical UO_2 particles 10 to 25 microns in diameter. (AEC)

18982 METHOD FOR THE RECOVERY AND PURIFICATION OF GASEOUS UF_6 FROM GASEOUS MIXTURES AND UF_7NO AND UF_7NO_2 PRODUCTS PRODUCED THEREBY. P. R. Ogle, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,039,846. June 16, 1962.

A method is given for recovering uranium hexafluoride from a gaseous mixture containing said uranium hexafluoride and extraneous gaseous impurities. The method comprises reacting said mixture with a nitrogen oxyfluoride at a temperature in the range −100 to 50°C to thereby form a solid compound having the empirical formula $UF_7N(O)_x$ where x is a number from 1 to 2. (AEC)

18983 FLAME DENITRATION AND REDUCTION OF URANIUM NITRATE TO URANIUM DIOXIDE. William H. Hedley, Robert J. Roehrs, and Courtland M. Henderson (to U. S. Atomic Energy Commission). U. S. Patent 3,041,136. June 26, 1962.

A process is given for converting uranyl nitrate solution to uranium dioxide. The process comprises spraying fine droplets of aqueous uranyl nitrate solution into a high-temperature hydrocarbon flame, said flame being deficient in oxygen approximately 30%, retaining the feed in the flame for a sufficient length of time to reduce the nitrate to the dioxide, and recovering uranium dioxide. (AEC)

Separation Processes

18984 (DP-671) EVALUATION OF HYDROCARBON DILUENTS FOR THE PUREX PROCESS. Burton P. Dennis and David L. West (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1961. Contract AT(07-2)-1. 31p.

Forty-nine hydrocarbon products were evaluated in the laboratory in a search for a highly stable diluent for the organic extractant used in a radiochemical separations plant. The formation of zirconium ligands during chemical and radiolytic degradation increased with boiling point for isoparaffinic products but was approximately constant for n-paraffins. Of those materials that met the local flash point specification, the n-paraffins were superior. (auth)

18985 (DP-720) PROCESSING OF POWER REACTOR FUELS. Seventeenth Quarterly Progress Report, October 1, 1961 to January 1, 1962. Vincent P. Caracciolo, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1962. Contract AT(07-2)-1. 16p.

Tests of electrolytic dissolution in the laboratory and semiworks confirmed that stainless steel can be dissolved at substantially higher rates in a vessel of a given size when a "liquid contact" method is used rather than the

"metal contact" method studied previously. Methods of scaling up the two types of dissolvers are given. (auth)

18986 (HW-62689) CONTINUOUS ION EXCHANGE DEVELOPMENT—A QUALITATIVE REVIEW. G. A. Nicholson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1959. Contract AT(45-1)-1350. 11p.

The development of ion exchange processes for recovery of fission products from aqueous waste streams and the separation and purification of fissionable materials from spent reactor fuels is reviewed. The characteristics of an optimized continuous countercurrent contactor are defined. Each of the following contactor designs are described and the advantages and disadvantages listed: fixed, packed-bed column; fixed, fluidized-bed column; moving, packed-bed column; continuous countercurrent fluidized column-differential contactor; and continuous countercurrent fluidized column-mixer-settler type. (M.C.G.)

18987 (HW-73135) PEROXYACETATE SEPARATION OF CERIUM(IV) FROM TRIVALENT RARE EARTHS IN PUREX PROCESS SOLUTIONS. L. F. Lust and H. H. Van Tuyl (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 26, 1962. Contract AT(45-1)-1350. 10p.

The precipitation of cerium from full-activity-level Purex process solutions, using sodium acetate and hydrogen peroxide, was investigated. The stability of the precipitate was found to depend on time, temperature, and activity level of the solution. However, either periodic additions of peroxide, or addition of a large excess of peroxide was found to yield adequate precipitation of the cerium. The process was applied batchwise to 200 gallons of rare earth crude prepared by the Purex plant. The resulting trivalent rare earth fraction contained about 70% of the initial promethium and only about 7% of the initial cerium and was of good quality for further purification by ion exchange. (auth)

18988 (ORNL-TM-223) TESTING OF EQUIPMENT FOR REMOVING NICKEL FROM HRT FUEL, USING UO_4 PRECIPITATION. O. O. Yarbro (Oak Ridge National Lab., Tenn.). Feb. 12, 1962. Contract [W-7405-eng-26]. 11p.

A system for the removal of nickel and other soluble contaminants from HRT fuel, based on UO_4 precipitation, was tested using synthetic fuel prepared from natural uranium. Ninety-nine per cent removal of nickel and other ionic constituents was demonstrated with uranium recovery in the range of 96 to 98%. (auth)

18989 EXTRACTION OF COMPLEXES OF STRONTIUM WITH THENOYLTRIFLUOROACETONE. Z. Kolařík and H. Pánková (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Collection Czechoslov. Chem. Communs., 27: 166-71(Jan. 1962). (In German)

The extraction of complexes of strontium with thenoyltrifluoroacetone using organic solvents was investigated as a function of the hydrogen ion concentration in the aqueous phase, the initial concentration of the thenoyltrifluoroacetone in the organic phase, and the polarity of the organic solvent used. The optimum conditions for the extraction and re-extraction of strontium were found, and the composition and stability of the complexes formed in the system study were determined. (tr-auth)

18990 CONTINUOUS COUNTERCURRENT ION-EXCHANGE SEPARATION. V. I. Gorshkov, I. A. Kuznetsov, and G. M. Panchenkov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 143: 643-5(Mar. 21, 1962). (In Russian)

Most countercurrent ion-exchange processes are not continuous because the solid and liquid phases are moved in succession as in the Higgins and Porter contactors. It is proposed that separation be carried out on two countercurrent ion-exchange columns. Resin saturated with the ion C is fed to the top of column 1, and a continuous frontal analysis is carried out on the salt mixture of AB and BZ that is to be separated. The ion C is displaced by the ions A and B. The solution CZ is withdrawn from the top of column I. Resin saturated with the ions A and B is withdrawn from the bottom of column I and is sent to the top of column II where it is eluted with a solution DZ. The resulting solution of AZ + BZ from the top of column II is fed to the bottom of column I. Resin saturated with the ion D is withdrawn from the bottom of column II and sent to the regenerator where it is contacted with the solution CZ. Resin saturated with the ion C is fed to the top of column I. The solution DZ from the regenerator is fed to the bottom of column II. The ion A gradually accumulates in column I, and ion B accumulates in column II. This countercurrent separation scheme is similar to that proposed by Spedding (J. Am. Chem. Soc., 77: 1393, 6125(1955) and U. S. patent 2,889,205), but is somewhat more flexible. A mixture of 0.4 N Li_2SO_4 and Na_2SO_4 was separated by this scheme on a sulfonic type of cation exchanger (KU-2). It was found that the Li fraction on column I contained $<10^{-5}$% Na, and the Na fraction on column II contained $<10^{-4}$% Li. (TTT)

18991 AN INTERMITTENTLY PULSED SPRAY-PACK COLUMN FOR LIQUID-LIQUID EXTRACTION WITH HIGH SEPARATION EFFICIENCY. R. Kiessling and K. Wetzel (Institut fur Physikalische Stofftrennung der DAdW, Leipzig). Kernenergie, 5: 28-34(Jan. 1962). (In German)

A spray-pack column, working by the mixer-settler principle, for liquid-liquid extraction is described. In this column the liquid stream, in order to obtain a high ground efficiency and a large through-put with constant velocity and to obtain a low ground clearance in a direction deviating from the column axis, was introduced in the unseparated phase. With such a column, ground efficiencies of over 60% and separation stage heights of 8 mm could be obtained. A qualitative evaluation (preliminary only) of the effect of the operating conditions on the ground efficiency and separation stage heights is given. (tr-auth)

18992 PROCESSING OF URANIUM DIOXIDE FUEL BY CHLORIDE FRACTIONAL DISTILLATION. Takehiko Ishihara, Kenmei Hirano, and Toshio Honda (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 231-9(Apr. 1962). (In English)

Using the difference in vapor pressure between the chlorides of uranium and those of fission products, a chlorination-distillation process for irradiated uranium dioxide fuel was tried. Cold experiments on a mixture of UO_2 and ZrO_2, MoO_3, CeO_2, or ThO_2, and on the semi-homogeneous reactor fuel (UO_2-C mixture) were carried out with the chlorination agent CCl_4 vapor flowing through a quartz reaction tube assembly at various reaction and condensation temperatures. In proper conditions, 98% of Zr, 99% of Mo, or 99% of Ce could be separated from U, and 95% of U was recovered from the semi-homogeneous reactor fuel. Most fission product elements, except Cd and Cs, are thought to be separated from U by chlorination-distillation treatment. (auth)

18993 IN-LINE RADIOMETRIC PROCESS MONITORS. [PART] 1. H. Bisby, F. D. Seymour, G. F. Snelling, and J. H. Wilkins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power, 7: No. 74, 59-61 (June 1962).

In-line radiometric process monitors for monitoring

plutonium and fission product concentrations in the Windscale separation plant are described. The separation plant is a large scale process for the wet-treatment of spent reactor fuel rods. Schematic diagrams are given of the monitor channels and sampling arrangement. (N.W.R.)

18994 MUTUAL SOLUBILITY IN THE AQUA SYSTEMS, WHICH COMPRISE URANYLNITRATE AND NITRATES OF OTHER ELEMENTS. M. A. Yakimov and N. F. Nosova. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 106-14(1961). (In Russian)

The mutual solubility in three triple systems $UO_2(NO_3)_2-Zn(NO_3)_2-H_2O$, $UO_2(NO_3)_2-Cd(NO_3)_2-H_2O$ and $UO_2(NO_3)_2-H_2O$ at 25 and 0°C was studied. No interaction resulting in the formation of new solid phases was observed in the temperature interval. From the data on solubility in the aqueous phase a conclusion may be drawn concerning the distribution of uranyl nitrate between aqueous and organic phases, when the nitrates of other elements are used for increasing the transition of uranyl nitrate into the organic phase. (auth)

18995 INVESTIGATION OF Zr COMPLEX FORMATION WITH α AND β AMINOPROPIONIC ACIDS IN NITRIC SOLUTIONS BY EXTRACTION METHOD. A. S. Solovkin, Z. N. Tsvetkova, and N. S. Povitskii. Zhur. Neorg. Khim., 7: 937-9(Apr. 1962). (In Russian)

The influence of α-alanine on the distribution coefficient in TBP-aqueous nitrate extraction of Zr was investigated. It was found that 0.1 M alanine had no influence on the distribution. (R.V.J.)

18996 REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 5, No. 1. Stephen Lawroski, ed. (Argonne National Lab., Ill.). Jan. 1962. 79p. $0.55 (GPO)(Domestic), $0.70(GPO)(Foreign).

A review is presented on subjects in the area of fuel processing in which significant new results were obtained. Included are sections concerned with commercial aspects of fuel processing, aqueous and nonaqueous processing, waste disposal, production of U, Th, Pu, and their compounds, and fuel processing safety. (J.R.D.)

18997 SEPARATION PROCESSES IN PRACTICE. A Collection of Papers Originally Presented in Philadelphia, Penna., March 1960. Robert F. Chapman, ed. New York, Reinhold Publishing Corporation, 1961. 214p.

Seven papers presented on March 29, 1960 at the Eighth Annual All-Day Meeting of the Philadelphia-Wilmington Section of the American Institute of Chemical Engineers are given. The topics covered are fundamentals of mass transfer processes, fundamentals in the design of liquid extraction processes, ion exchange, scale-up and performance relations for continuous crystallizers, preliminary evaluation of electric membrane processes for chemical processing applications, separation of aromatics and paraffins by solvent extraction, and comparison of tray types in fractionation columns. (M.C.G.)

18998 SEPARATION OF SILICA FROM ZIRCONIUM OR FROM ZIRCONIUM AND HAFNIUM. Malcolm Korach and James Kellett Thomas, III (to Pittsburgh Plate Glass Co. and Columbia-National Corp.). British Patent 896,053. May 9, 1962.

A process is given for separating Zr and SiO_2 from each other in zircon. The process comprises reacting zircon with an alkali metal hydroxide or carbonate to convert part of the silica to alkali metal silicate, extracting the silicate with water, dissolving the residue in H_2SO_4 to give a solution containing 10 to 45 wt % free H_2SO_4, and heating the solution at $\geq 125°F$ to precipitate the remaining SiO_2. (D.L.C.)

18999 IMPROVEMENTS IN OR RELATING TO THE SEPARATION OF TECHNETIUM FROM FISSION PRODUCT SOLUTIONS. Gwilym Morgan Phillips and Joseph Jackson Hillary (to United Kingdom Atomic Energy Authority). British Patent 896,758. May 16, 1962.

A method is given for separating Tc from fission product solutions arising in the processing of irradiated nuclear fuel. An acidified nitrate solution of fission products is made alkaline with NaOH, the alkaline solution is passed through a strongly basic anion exchange resin, and Tc is eluted from the resin with HNO_3. The eluate may be purified further from Fe, Cr, and Ru by complexing the Fe as a tartrate, making the solution alkaline, and extracting the Tc with methyl ethyl ketone. (D.L.C.)

19000 IMPROVEMENTS IN OR RELATING TO EXTRACTION OF BERYLLIUM FROM BERYL ORE. Kenneth Robert Hyde and Michael James Waterman (to United Kingdom Atomic Energy Authority). British Patent 896,812. May 16, 1962.

A process for extracting Be from beryl ore is outlined in which only a minor proportion of the Al in the ore is also extracted. The process comprises leaching the ore with an aqueous solution containing 0.2 to 5 N H_2SO_4 and 0.1 to 0.5 N HF at a temperature between 200°C and the critical temperature of the leaching solution, preferably at least 300°C. (D.L.C.)

19001 PROCESS FOR THE SEPARATION OF URANIUM AND ZIRCONIUM. (to Dow Chemical Co.). British Patent 896,891. May 23, 1962.

A pyrometallurgical process is given for separating U from Zr in a U-Zr alloy. The process comprises contacting the U-Zr alloy with molten Al at 800 to 900°C for an extended period of time and separating the Zr-containing precipitate. The precipitate may be further treated with molten Al to recover additional U. (D.L.C.)

19002 EXTRACTION APPARATUS. (to Allmanna Svenska Elektriska Aktiebolaget). British Patent 896,959. May 23, 1962.

A series-coupled pulsed column of the ASEA type is designed which gives complete freedom in its dimensioning and construction. The column is made to pulsate at two frequencies, one for the transport of liquid between the vessels and the others for aiding the extraction. The column may be dimensioned for minimum floor surface and shielded volume for processing of radioactive substances. (D.L.C.)

19003 PROCESS FOR THE SEPARATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 897,261. May 23, 1962.

A process is outlined for separating radioactive elements from plutonium in irradiated uranium. The process comprises forming an acid solution of the irradiated uranium with a pH of 2 or less, precipitating plutonous iodate, dissolving the precipitate in acid, oxidizing the plutonium to the hexavalent state, and precipitating an insoluble iodate to leave a supernatant plutonyl iodate solution. The preferred insoluble iodate carrier is cerium or thorium iodate. An example of the process is given in which plutonium is separated from irradiated uranyl nitrate hexahydrate. (D.L.C.)

19004 SEPARATIONS BY ELECTRODIALYSIS. William H. Webb and Jerry D. Vie (to U. S. Atomic Energy Commission). U. S. Patent 3,038,844. June 12, 1962.

A method is given for separating cesium, cerium, zirconium, and uranyl ions from a common solution by electrodialysis. An anion exchange membrane and a cation exchange membrane are placed on either side of the feed

solution compartment; the former is in electrolytic contact with an anode and the latter with cathode. On acidification of the feed solution to a critical value of 0.5 N and passage of a current from the anode to the cathode, the desired separations take place. (AEC)

19005 SEPARATION OF METAL VALUES FROM NUCLEAR REACTOR. D. O. Campbell and G. I. Cathers (to U. S. Atomic Energy Commission). U. S. Patent 3,039,847. June 19, 1962.

A method is given for separating beryllium fluoride and an alkali metal fluoride from a mixture containing same and rare earth fluorides. The method comprises contacting said mixture with a liquid hydrogen fluoride solvent containing no more than about 30 per cent water by weight and saturated with a fluoride salt characterized by its solubility in anhydrous hydrogen fluoride for a period of time sufficient to dissolve said beryllium fluoride in said solvent. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

19006 (ANL-6533) A PINHOLE CAMERA AUTORADIOGRAPHIC TECHNIQUE FOR ENCAPSULATED IRRADIATED FUEL SPECIMENS. W. N. Beck (Argonne National Lab., Ill.). Apr. 1962. Contract W-31-109-Eng-38. 8p.

A gamma pinhole camera was devised to permit a nondestructive examination of irradiated specimens while still in sealed capsules. The camera was designed such that a complete experiment may be withdrawn from an irradiation facility, the specimen autoradiographed, and the experiment then reinserted if so desired. The pinhole aperture is 0.020 in., and the source to pinhole block is 4 ft. The image-to-source sizes are a one-to-one ratio. The resolution of the image is 0.03 in. (auth)

19007 (ANL-6557) PLANNING, SCHEDULING, AND EXPEDITING ENGINEERING PROJECTS WITH THE AID OF ELECTRONIC COMPUTERS (thesis). John Corbin Pollock (Argonne National Lab., Ill.). May 1962. Contract W-31-109-eng-38. 126p.

Submitted to Illinois Inst. of Tech., Chicago.

Two methods for planning, scheduling, and monitoring engineering and scientific research and development projects are discussed. They are the Critical Path Method and PERT. The specific development and implementation of network analysis techniques being used in the construction of the Zero Gradient Synchrotron are described. The historical development of the Critical Path Method and PERT is outlined. Network diagrams, numbering network diagrams, activity duration times, mathematical evaluation of the network, government and industrial use of PERT and CPM, and applications of network analysis techniques are discussed. (M.C.G.)

19008 (DC-60-3-77) PRELIMINARY DESIGN—AN ELECTRICAL HEATER FOR HEATING AIR FROM 80°F TO 2750°F CONTINUOUSLY WITHOUT CONTAMINATION. S. E. Eckard (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 3, 1960. Contract AT(11-1)-171. 71p.

Design criteria and a preliminary design of an air heater which is potentially capable of heating 5 lb/sec of air to 2750°F are presented. Heating may be continuous for periods up to 1000 hours without air stream contamination. The potential heater life is well over 2000 hours. Electrically heated silicon carbide heating elements are used as the heat source. These elements are enclosed by silicon nitride bonded silicon carbide tubes to isolate them from direct contact with the moving air stream. The tubes are also pertinent for efficient heat transfer. (auth)

19009 (DP-680) A MINIATURE CENTRIFUGAL CONTACTOR. Alfred S. Jennings (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1962. 24p. Contract AT(07-2)-1.

A miniature centrifugal contactor was developed for liquid-liquid extraction with mass transfer efficiencies of 95% at a residence time of 3 sec per stage. A 16-stage contactor was designed that is suitable for remote operation with highly radioactive materials. (auth)

19010 (DP-708) DESIGN OF A Co^{60} IRRADIATION FACILITY. Rolland W. Ahrens and Edward J. Boudreaux (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1962. Contract AT(07-2)-1. 12p.

An underwater irradiation facility was designed and built for the study of the effects of gamma radiation on various materials. Radiation fields of reasonable uniformity and with intensities up to 2.2×10^6 r/hr are provided by 11,500 curies of Co^{60}. (auth)

19011 (KAPL-M-JOS-1) COMPRESSION LOAD CELL FOR MEASUREMENT OF SEAL COMPRESSION FORCES. John Swota, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 12, 1962. Contract W-31-109-Eng-52. 6p.

A load monitoring device was incorporated into a Conax seal test fixture, and a test procedure was developed to determine the relationship between applied torque and the resulting compression load impressed on teflon seals as a function of various design parameters such as follower configuration and lubrication effects. The load cell performance was satisfactory. Periodic calibrations indicated that load values are accurate to within ±0.5% of full load values. (M.C.G.)

19012 (KAPL-M-JVM-3) TRANSIENT THERMAL STRESS IN THIN CYLINDERS. Julius A. Mirabal and Judith K. Van Voorhis (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 1962. Contract W-31-109-eng-52. 31p.

A correction to results in the published literature is presented. Formulas and curves are given for the transient thermal stress in a flat slab which is insulated on one surface and exposed on the opposite surface to a linear temperature increase ΔT in time t_1; the results are also applicable to thin-walled cylinders. Curves are given for the stress on the exposed surface, the mean temperature in the slab, and the stress on the insulated surface. In addition, graphs are given for determining the imposed transient from the observed temperature on the insulated surface. (auth)

19013 (NP-11676) DIELECTRIC HEATING: AN ANNOTATED BIBLIOGRAPHY. Helen M. Abbott, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Feb. 1962. 20p. (SB-61-55)

Fifty-seven references pertaining to the dielectric or high-frequency heating of non-conducting materials are given to reports, books, and U. S. and foreign journals published from February 1951 to July 1961. (P.C.H.)

19014 (ORNL-310) SURVEY OF ELECTROSTATIC PRECIPITATORS FOR SEPARATION OF RADIOACTIVE PARTICLES. F. C. McCullough, J. A. Lane, and F. L. Culler (Oak Ridge National Lab., Tenn.). Feb. 16, 1949. Contract [W-7405-eng-26]. 89p.

The discharge of radioactive particles from the pile cooling air stack and from chemical processing and experimental facilities at ORNL presents a serious health hazard to laboratory personnel. Facilities for cleaning the exhaust gas were investigated, and the efficiencies of various types of cleaners such as filters, cyclones, and electrostatic precipitators were reviewed. The cleaning of these gases presents a most difficult problem because of the extremely high efficiencies required (99.9% or better removal of all particles down to 0.1 micron in diameter), and because of the low dust loading. Electrostatic precipitators now produced commercially have been studied and evaluated with respect to ORNL problems. The economics of many types

of electrostatic precipitators were investigated. The general conclusion as a result of this survey is that at the present time there is no commercially available unit that offers high efficiencies on a sound economic basis. The general requirements for a satisfactory electrostatic precipitator are formulated. An experimental precipitator and program of investigation is proposed. (auth)

19015 (SCTM-362-61(73)) REDUCTION OF STRAIN GAGE DATA. P. H. Adams and R. C. Dove (Sandia Corp., Albuquerque, N. Mex.). Jan. 1962. Reprinted Apr. 1962. Contract [AT(29-1)-789]. 44p.

Commonly encountered errors resulting from the evaluation of stress from readings taken on a single-element electric resistance strain gage in a biaxial stress field are discussed. Complete formulas and nomograph construction details needed for the reduction of data from strain gages to stresses are presented. (auth)

19016 (Y-1387) COMPUTER SCHEDULING OF LUBRICATION. D. T. Martin, W. M. Williams, Jr., and C. W. Wilson (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Nov. 21, 1961. Contract W-7405-eng-26. 42p.

Methods were developed at Y-12 for preparing routine lubrication schedules through the use of electronic data processing equipment whereby each lubricator has a predetermined route to be followed and a daily leveled work load assignment. These schedules are used by craftsmen in performing routine lubrication on pieces of equipment that have a large number of points to be lubricated. A wide variation in frequency, types of lubricants, and execution times is encountered. (auth)

19017 (AEC-tr-5108) PICKLING OF NEW HIGH PRESSURE BOILERS. K. Rummel. Translated by Eugene E. Gruber (Carnegie Inst. of Tech., Pittsburgh) from Mitt. Ver. Grosskesselbesitzer, No. 53, 92-8(Apr. 1958). 13p.

Six boilers were subjected to a pickling treatment for removal of the scale layer. Various methods of pickling were investigated to determine the one giving the best results. It was concluded that the boilers could be pickled successfully with 5 to 6% HCl and 0.2% hexamethyltetramine as an inhibitor, without circulating the acid, for 12 hours at room temperature. The boilers were then rinsed and a base (NaOH or NH_4OH) was used to neutralize the surface. Good results were obtained. (M.C.G.)

19018 THE PENNING ION SOURCE. Jánes Nagy. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 211-30(1961). (In Hungarian)

The Penning-type cold-cathode ion source, developed from a low-pressure vacuum gauge, has a high operating voltage and is characterized by the oscillation of electrons leaving the cold cathode in the magnetic field between the electrodes. The source is suited for preparing ions with multiple charges such as N^{3+}, C^{3+}, He^{2+}, and S^{6+}. While in general the H_1^+,D_1^+ content is around 30%, their proportion may reach 90% under certain conditions of high arc current and high magnetic field. By means of a relatively simple pulsed operation, a high charge density plasma, concentrated in a small volume may be created. The source presents the advantages of low energy consumption and high electrical efficiency; its construction is simple and its life may be made as long as required. It possesses also the magnetic field required for operation in a cyclotron or a synchrocyclotron. There is a correlation between the maximum ion current and the pressure in the discharge air space: the optimum pressures range from a few to about 20 microns of Hg. The pertinent literature is reviewed and the properties of the various types of Penning sources are tabulated. (36 references). (TTT)

19019 SIMPLE TOOLS FOR REMOTE RADIOACTIVE OPERATIONS. János Schadek and Csaba Ujhelyi. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 235-6(1961). (In Hungarian)

A few relatively simple but effective tools have been developed in the shops of the Institute of Nuclear Research of the Hungarian Academy of Sciences in Debrecen for the remote handling of experimental equipment. They include special clamps, found useful for handling and grasping cylindrical objects such as sources, glass ampoules, beakers, etc. A special head facilitates operations involving wires or similar very thin objects. An automatically grasping, spring-loaded tool rendered good service for manipulating sealed sources; a thin steel or plastic wire was used to open the clamp against the pressure of the spring. (TTT)

19020 VACUUM TECHNOLOGICAL DEVICES AND INSTRUMENTS DEVELOPED AT THE INSTITUTE OF ATOMIC RESEARCH. István Berecz. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 237-45(1961). (In Hungarian)

In view of the great importance of high-vacuum techniques in many phases of modern technology, the Institute scientists and engineers developed several specialized devices. The equipment developed is in use in many diverse fields in addition to purely nuclear applications, including the applications of vacuum coatings to reduce reflection losses on optical surfaces, manufacture of electron tubes, cathode and TV tubes. Chemical applications involve the preparation and drying of unstable organic compounds. The devices were also used in research equipment, such as spectrometers, spectrographs, electron microscopes, etc. The apparatus developed includes a diffusion pump with a preliminary and 2 evacuating stages which create a vacuum of $5 \cdot 10^{-6}$ mm of Hg. A steam jet pump was designed for removing relatively large amounts of gases at a final pressure of 10^{-2} to 10^{-3} mm Hg. An oil-steamjet pump reached a vacuum of $5 \cdot 10^{-5}$ mm of Hg. Remotely controllable electromagnetic valves were also developed. Previous designs of Pirani and ionization gauges were further improved. The institute's new leak detector has a lower sensitivity than previous instruments but is of a simple construction and uses inexpensive H gas. (TTT)

19021 MULTILAYER SHELL MAKES SAXTON VESSEL 10% CHEAPER. Leonard R. Katz (Westinghouse Electric Corp., Pittsburgh), Edward A. Goldsmith, and Joseph J. Maurin. Nucleonics, 20: No. 6, 88; 91-3(June 1962).

By fabricating the 5-in.-thick steel shell of the Saxton reactor vessel of multiple layers instead of a solid wall, over-all vessel cost is reduced by about 10%. The design, construction, and performance of the Saxton vessel are discussed along with the problems and solutions of fabrication. Because multilayer vessels do not need to be stress-relieved, costly on-site stress-relieving operations needed for large solid-wall vessels are unnecessary. (N.W.R.)

19022 HOW TO SELECT GAMMA SHIELDING DOORS. John M. Ruddy (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 20: No. 6, 94-5(June 1962).

Shield doors for hot cells, gamma irradiation cells, x-ray machines, and accelerators are selected according to basic features and requirements of the facilities. The choice of door type depends on user plans for cell arrange-

ment, type of work anticipated, and traffic access as well as door characteristics such as methods of support and motion, size, material, auxiliary shielding, drive mechanism, and space needed. Shield doors must provide both full shielding and ready access at the lowest cost consistent with operating criteria such as minimum and maximum speeds of opening and closing, ease of decontamination, and simplicity of maintenance. (N.W.R.)

19023 IMPROVEMENTS IN OR RELATING TO MEANS FOR VIEWING AN ELEMENT LOCATED WITHIN AN ENCLOSED SPACE. Stanley Charles Frederick Wills (to Strachan & Henshaw Ltd.). British Patent 895,893. May 9, 1962.

An apparatus is designed for viewing a deeply indented element, e.g., a finned fuel element, within a pressurized enclosed space, such as the pressurizable servicing path from a charge/discharge machine to a reactor pressure vessel. The apparatus includes a viewing beam path and an illuminating beam path arranged in parallel and directed through a single aperture; a pair of right-angle prisms is provided in the illuminating beam path to bring it closer to the viewing beam path. (D.L.C.)

19024 IMPROVEMENTS IN OR RELATING TO SEALED JOINTS. William Paul White (to United Kingdom Atomic Energy Authority). British Patent 896,352. May 16, 1962.

A sealed flanged joint is designed for use between pipes of metals having different thermal expansion coefficients. The joint is formed between abutting sealing faces with bolts which are tightened to render one joint member plastic. An example of the joint is described which was used to join a zirconium pipe and a mild steel pipe. (D.L.C.)

19025 IMPROVEMENTS IN OR RELATING TO AUTOCLAVES. Michel Douis and Henri Laurent (to Commissariat a l'Energie Atomique). British Patent 896,465. May 16, 1962.

An autoclave is designed which may be operated remotely for the sterilization of radioactive substances, particularly these substances emitting gamma rays. (D.L.C.)

19026 IMPROVEMENTS RELATING TO NUCLEAR REACTOR EQUIPMENT. Robert Ross Huitson (to Associated Electrical Industries Ltd.). British Patent 897,387. May 23, 1962.

A blower for effecting circulation of a gas coolant through a heat exchanger is designed to prevent back flow of gas through the heat exchanger while the blower is shut down. The blower includes a non-return valve in the output side to prevent such reverse flow, and by a bypass conduit between the output side and the input side and arranged to open or close when the non-return valve closes or opens, respectively. (D.L.C.)

19027 AEROSOL SAMPLER. Evan C. Evans, III and Frederic A. French (to Dept. of the Navy). U. S. Patent 3,035,445. May 22, 1962.

A sampler for precipitating solid and liquid particles from an aerosol is designed which has a high impaction efficiency for smaller particles, provides a permanent record of the particle size as a function of time, and prevents the break-up of large particles into smaller ones. The precipitating head has a plurality of pins around the intake port, and a d-c high voltage potential is applied to the pins to cause continuous corona discharge which accelerates the aerosol and strips the particles therefrom. The particles are precipitated onto a moving film before the charged pins and intake port. (D.L.C.)

19028 EVAPORATORS. Peter Waine and Derek Edmund Abel (to United Kingdom Atomic Energy Authority). U. S. Patent 3,035,634. May 22, 1962.

An evaporator for concentrating solutions is designed which gives continuous and automatic operation. The evaporator comprises a boiler, a vapor/liquid separator, a feed solution inlet to the boiler, a concentrated solution outlet from the boiler, and a valve in the outlet actuated by a device sensitive to the concentration of separated liquid passing back to the boiler. (D.L.C.)

19029 MASS TRANSFER INHIBITOR FOR LIQUID METAL HEAT TRANSFER SYSTEM. William E. Miller (to Chrysler Corp.). U. S. Patent 3,036,011. May 22, 1962.

A method is given for restricting the mass transfer of Fe crystals to the cold zone of a liquid Pb and/or Bi heat transfer system. The method comprises suspending Mo powder in the heat transfer system; the Mo powder serves as a nucleus for Fe atoms dissolving from the container surface into the hot liquid metal and prevents the deposition of Fe on cold surfaces and consequent plugging of the system. A suitable Mo concentration is ~5 atoms per million atoms of Pb and/or Bi. (D.L.C.)

19030 APPARATUS FOR ACCELERATING MICRON-SIZE PARTICLES TO METEORIC VELOCITIES. Alexander J. Dessler, James F. Vedder, and Martin Hertzberg (to Lockheed Aircraft Corp.). U. S. Patent 3,036,213. May 22, 1962.

An apparatus is designed for accelerating micron-size particles to meteoric velocities for impact studies of materials which may be used as spacecraft surfaces. In the apparatus, micron-size diamond particles are injected into an electrodynamic suspension chamber in a state of high vacuum, and one particle is charged to a high charge-to-mass ratio by a high-energy Ar ion beam and accelerated by an electric gun to impact on a surface being tested. (D.L.C.)

19031 METHOD FOR PUMPING GASES AT LOW VACUUM PRESSURES. Norman Milleron (to U. S. Atomic Energy Commission). U. S. Patent 3,037,685. June 5, 1962.

A method is given for pumping overpressure "pulses" or "bursts" of gases without a significant rise in base pressure within a "gettering-type" vacuum pump having surfaces within the pumping cavity coated with or comprising clean gettering metal, e.g., Mo or Ta. The cavity is first pumped down by any convenient means to an equilibrium base pressure in the range desired, generally below 10^{-6} mm Hg. At this pressure, the metal immediately adsorbs overpressures or "bursts" of gases striking same with thermal motion without raising the base pressure significantly. Desorption takes place at an equilibrium rate which, of course, is dependent upon the equilibrium pressure, and such desorbed gases are continuously removed by diffusion pump or other pumping, whereby said overpressures or "bursts" of gases are removed without a rise in the equilibrium pressure and/or back diffusion of the gaseous pulse from the pumping cavity. (AEC)

19032 THREADED ADAPTOR FOR LUGGED PIPE ENDS. John E. Robb (to U. S. Atomic Energy Commission). U. S. Patent 3,037,796. June 5, 1962.

An adaptor is designed for enabling a threaded part to be connected to a member at a region having lugs normally receiving bayonet slots of another part for attachment of the latter. It has been found desirable to replace a closure cap connected in a bayonet joint to the end of a coolant tube containing nuclear-reactor fuel elements, with a threaded valve. An adaptor is used which has J-slots receiving lugs on the end of the reactor tube, a thread for connection with the valve, and gear-tooth section enabling a gear-type of tool to rotate the adaptor to seal the valve to the end of the reactor tube. (AEC)

19033 VACUUM SEALING MEANS FOR LOW VACUUM PRESSURES. Norman Milleron (to U. S. Atomic Energy Commission). U. S. Patent 3,038,731. June 12, 1962.

A vacuum seal is designed in which the surface tension of a thin layer of liquid metal of low vapor pressure cooperates with adjacent surfaces to preclude passages of gases across pressure differentials as low as 10^{-3} mm Hg. Mating contiguous surfaces composed of copper, brass, stainless steel, nickel, molybdenum, tungsten, tantalum, glass, quartz, and/or synthetic mica are disposed to provide a maximum tolerance, D, expressed by $2\gamma/P_1$, where γ is the coefficient of the surface tension of the metal sealant selected in dynes/cm^2. Means for heating the surfaces remotely is provided where temperatures drop below about 250°C. A sealant consisting of an alloy of gallium, indium, and tin, among other combinations tabulated, is disposed therebetween after treating the surfaces to improve wettability, as by ultrasonic vibrations, the surfaces and sealants being selected according to the anticipated experimental conditions of use. (AEC)

19034 ELECTRIC BLASTING INITIATOR. Lawrence H. Johnston (to U. S. Atomic Energy Commission). U. S. Patent 3,040,660. June 26, 1962.

An electric blasting initiator comprises a shell, a high explosive material within the shell, and an exploding bridge wire in contact with said explosive material. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstracts 18944, 18945, and 19949.

19035 (AFSWC-TN-61-29(Pt.I)) AFSWC SECOND HYDRODYNAMIC CONFERENCE [ON] NUMERICAL METHODS OF FLUID FLOW PROBLEMS, MAY 16-18, 1961. John C. Rich, comp. (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). 206p. (AD-268299)

A total of 13 papers is included. Separate abstracts were prepared for 4 of these. None of the other papers were previously abstracted in NSA and are concerned with hydrodynamics codes, early solar evolution, computer programs for fluid flow, shock-induced reactions, calculation of spall, deflection of shell structures, motion in elastic half spaces, and numerical integration schemes. (J.R.D.)

19036 (AFSWC-TN-61-29(Pt.I)(p.20-45)) ANALYTIC METHODS AND APPROXIMATIONS OF MHD PROBLEMS. J. D. Cole (California Inst. of Tech., Pasadena) and C. Greifinger (RAND Corp., Santa Monica, Calif.).

An analysis is presented of the various devices designed to accelerate gases to thermonuclear energies. Simplifying approximations used in the analysis include idealization of apparatus geometry, idealization of gas physical and mechanical properties, and neglect of the gas-external circuit reactions. (J.R.D.)

19037 (AFSWC-TN-61-29(Pt.I)(p.46-77)) NUMERICAL APPROXIMATIONS FOR WEAK SOLUTION OF MIXED INITIAL-BOUNDARY VALUE PROBLEMS OF FLUID FLOWS. W. McIlroy and M. Halem (Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.).

A survey is presented of problems being investigated in a general system of conservative hyperbolic equations with moving boundaries. A discussion of applications to physical problems is included. (J.R.D.)

19038 (AFSWC-TN-61-29(Pt.I)(p.125-38)) PROBLEMS OF RADIATION TRANSPORT IN HEATED AIR. R. K. M. Landshoff and R. E. Meyerott (Lockheed Aircraft Corp. Missiles and Space Div., Palo Alto, Calif.).

An analysis is presented of problems associated with emission and absorption of radiation which transfers energy from one point of an explosion fireball to another or to points in the interior. (J.R.D.)

19039 (AFSWC-TN-61-29(Pt.I)(p.139-49)) NUMERICAL METHODS FOR HYDRODYNAMICS WITH RADIATION TRANSPORT. R. A. Grandey (Aeronutronic. Div. of Ford Motor Co., Newport Beach, Calif.).

The discussion is concerned with the equations of radiation transport and numerical integration of transport equations. (J.R.D.)

19040 (APED-3892) BURNOUT LIMIT CURVES FOR BOILING WATER REACTORS. E. Janssen and S. Levy (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 1, 1962. 51p.

Burnout limit curves are recommended for the design of boiling water reactors. The recommended curves cover the following range of conditions: pressure at 600 to 1450 psia, a flow rate of 0.4 to 6.0×10^6 lb/hr-ft^2, steam subcooled to 45% by weight, hydraulic diameter from 0.245 to 1.25 in., and a heated length of 29 to 108 in. The basis for the burnout limit curves is discussed and their application to available data is presented. (auth)

19041 (ATL-A-122) EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF ULTRASONIC VIBRATIONS ON BURNOUT HEAT FLUX WITH BOILING WATER. Quarterly Technical Progress Report No. 3, April–June 1961. Fred E. Romie (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Work performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 7p. (EURAEC-157)

The heat-transfer loop was completed and is in operation. Difficulty was experienced in obtaining a sufficiently strong connection between the burnout-detector voltage tap and the heating element. This problem and its potential solution are described. The lack of means of obtaining controlled burnout prevented collection of data on the burnout effects of the ultrasonic field. (auth)

19042 (ATL-A-123) EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF ULTRASONIC VIBRATION ON BURNOUT HEAT FLUX WITH BOILING WATER. Final Summary Report, October 3, 1960–July 31, 1961. F. E. Romie and C. A. Aronson (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). July 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 23p. (EURAEC-217)

Experimental results were obtained on the effect of an ultrasonic field on the burnout heat flux for water flowing, at atmospheric pressure, through an annular flow channel formed by a $\frac{1}{4}$-in.-diameter electrically heated tube and a concentric glass tube of $\frac{3}{4}$-in. ID. The active length of the central heating element was $5\frac{1}{2}$ in. The ultrasonic transducer, which was operated at 25,000 cps and a maximum electrical input of 300 watts, was located at the inlet end of the flow channel. The ultrasonic waves were propagated in the water in the direction of flow and thus parallel to the surface of the heating element. Burnout conditions covered channel inlet flows from 1.61 to 6.25 ft/sec and subcooling from 16 to 28°F. No effect of the ultrasonic field on the burnout heat flux or on the visible boiling phenomena at burnout conditions was detectable. During boiling at heat fluxes well below burnout, the effect of the ultrasonic field was a reduction in the diameter of the envelope of bubble

activity surrounding the heating element. Visual inspection appeared to show that this reduction was associated with a smaller average bubble size and a greater frequency of bubble formation. However, all evidence of the presence of the ultrasonic field vanished as the flow velocity increased or as the heat flux increased to the burnout level. (auth)

19043 (DC-54-1-75) SOURCE BOOK FOR FLOW THROUGH PACKED BEDS. M. E. Lapides and R. C. Brubaker (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Jan. 12, 1954. Contract AT(11-1)-171. 61p.

Source material and recommended design equations for estimating the fluid flow and heat (or mass) transfer characteristics of packed beds are presented. Introductory material and design equations are given for the particular case of a fixed bed of uniform packing, in which the packing material is the source of the heat or mass being transferred to a single phase unit. (auth)

19044 (DC-55-8-129) THE INTERPRETATION OF DATA OBTAINED ON SHAPED WIRE FUEL ELEMENTS. Cover carries title: INTERPRETATION OF THERMODYNAMIC DATA ON ADVANCED FUEL ELEMENTS. Myron Tribus (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 26, 1955. Contract AT(11-1)-171. 21p.

A review of the underlying difficulties in the preparation and interpretation of heat transfer and pressure drop for fuel element assemblies is presented. Suggestions for interpreting and plotting data from various types of systems are given. An example from NACA literature is analyzed in detail. (auth)

19045 (DF57TG177) INCOMPRESSIBLE FLOW NETWORK CALCULATIONS. H. N. Cantrell and G. O. Mueller (General Electric Co. Large Steam Turbine-Generator Dept., Schenectady, N. Y.). Nov. 4, 1957. 53p.

A method and an IBM-704 program are described for calculating the flows and pressures in a fluid flow network. The method is extremely general and applies to almost any kind of network with any combination of fans or pumps and flow resistances. This method was applied successfully to sample flow problems in electrical machinery ventilation, air conditioning, natural convection, and many other more uncommon types. The 704 program is available on request. The method can be applied on any computer which can be used to invert and multiply matrices. (auth)

19046 (HW-SA-2564) AN EXPERIMENTAL INVESTIGATION OF TWO-PHASE FLOW PRESSURE LOSSES IN PIPE ELBOWS. Theodore Lee Deobald (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1962. Contract AT(45-1)-1350. 108p.

Thesis submitted to Univ. of Idaho.

Results of a study concerning two-phase steam–water flow through pipe elbows are presented. The applicability of the approach used in the analysis of this type flow, relating the pressure drop occurring during two-phase flow to the pressure drop occurring if only a single phase were flowing in the system, is examined. The work is limited to standard 1 in. welding ells with steam pressures at 25 to 50 psia and steam qualities of 0 to 100%. (J.R.D.)

19047 (TID-15190) LAMINAR FLOW THROUGH CHANNELS WITH POROUS WALLS. Helen S. Stearns, comp. (Los Alamos Scientific Lab., N. Mex.). July 22, 1959. Contract [W-7405-eng-36]. 15p. (D-BIB-32)

A bibliography is presented on laminar flow through tubes, pipes, and flat plates with porous walls. The 81 references are given alphabetically by author. (M.C.G.)

19048 (TID-15619) BASIC EXPERIMENTAL STUDIES ON BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report, March 1962. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Mar. 30, 1962. Contract AT(30-3)-167. 29p. (MPR-XIII-3-62)

The High Heat Flux 19-Rod Test Section was prepared for burnout testing. A schedule of future test section development is given. Extreme test section flow stability is demonstrated for burnout testing with 19-Rod Test Sections. A comparison of the transient thermal response of a typical reactor fuel rod and its electrically heated simulations operated is made which shows that the heater tube backup material has an important effect on the minimum time required to reach burnout temperatures during a thermal transient. (auth)

19049 (AEC-tr-5109) I. A FEW REMARKS ON THE SEALING OF ROTATING AND RECIPROCATING MACHINE PARTS. E. F. Boon. Translated by Cyrus Feldman (Oak Ridge National Lab., Tenn.) from Ingenieur (Utrecht), 64: No. 12, 33-40(1952). 40p.

Various formulas are given for calculating fluid flow through seals and the generation of heat. The minimum imbalance for a mechanical seal was calculated to be 50% for liquid flow and 66% for gas flow through the seal for zero spring tension. It is shown that contact between the seal faces cannot be avoided. The theory of Brkich, which assumes that the surface tension can prevent this direct contact is not accepted, because the shape of the interface at the downstream side of the seal as assumed by Brkich is highly improbable. As an example, formulas were used to calculate leakage of a seal of a high-pressure compressor and of a Flexibox mechanical seal. (auth)

19050 TEMPERATURE IN A COOLED, HEAT-GENERATING CYLINDER. H. Kraus (Westinghouse Electric Corp., Pittsburgh). Appl. Sci. Research, 10A: 419-29(1961). (In English)

The temperature and heat flux distribution in a long circular cylinder with a central circular channel surrounded by a ring of equally spaced circular channels are determined for the case of a uniform generation of heat in the cylinder material. The solution of the problem is accomplished by constructing and combining two temperature systems. The first of these has a pole of order n at the center of each eccentric channel and possesses an invariance that allows the boundary conditions to be met simultaneously at the surface of each eccentric channel, and the second is the familiar solution in n-th degree circular harmonics for the hollow cylinder with heat generation and an arbitrary symmetrical temperature distribution. Curves are presented for a variety of cases to demonstrate the effect of the various parameters that appear in the solution. (auth)

19051 THE EFFECT OF RADIATION UPON FORCED-CONVECTION HEAT TRANSFER. R. D. Cess (North Carolina State Coll., Raleigh). Appl. Sci. Research, 10A: 430-8(1961). (In English)

A study was made to determine the influence of radiation heat transfer upon the forced-convection Nusselt number. The particular situation considered was that of flow of a fluid transparent to radiation across a flat plate having a constant surface heat rate per unit area. The analysis was restricted to first order radiation effects, and these results were in turn employed to estimate under what conditions radiation may be neglected. It was found that the radiation influence may be extremely severe for laminar flow, but is considerably less important with regard to turbulent forced convection. (auth)

19052 A UNIFIED THEORY OF TURBULENT FLOW. IV. CYLINDRICAL COUETTE FLOW. William Squire (Southwest Research Inst., San Antonio, Tex.). Appl. Sci. Research, 10A: 439-56(1961). (In English)

A general theory of turbulent flow is applied to Couette flow between concentric cylinders. It appears that the basic differential equation of the theory is capable of describing the velocity profiles obtained experimentally if suitable assumptions are made about the structure of the flow and the numerical value of constants in the equation. However, in its present state of development, the theory is not capable of predicting the flow pattern from the Reynolds number and relative diameters of the inner and outer cylinders. The need is shown for additional experimental investigations to define the conditions for the appearance of the various flow patterns. (auth)

19053 THE SOLUTION OF THE HEAT TRANSFER EQUATION FOR LAMINAR FLOW IN AN ANNULUS. H. Eldor (Technion-Israel Inst. of Tech., Haifa). Bull. Research Council Israel, Sect. C, 11: 57-66(Apr. 1962). (In English)

The solution of the heat transfer equation for the case of fully developed laminar flow through an annular space is given in the form of a series of eigenfunctions with the corresponding eigenvalues. The problem is solved for a specified diameter ratio for the case of inner wall of the annulus kept at constant temperature and outer wall completely insulated. General solution is valid for any arbitrary inlet temperature profile and given for the specific case of uniform temperature at the inlet with four terms of the series. (auth)

19054 RADIANT TRANSFER OF HEAT IN MOLTEN INORGANIC COMPOUNDS AT HIGH TEMPERATURES. C. T. Ewing, J. R. Spann, and R. R. Miller (Naval Research Lab., Washington, D. C.). J. Chem. Eng. Data, 7: 246-50 (Apr. 1962).

The mechanisms by which heat is transferred in molten boric oxide and flinak (11.5 mole % NaF, 42% KF, and 46.5% LiF) are studied by determining the thermal conductivities at 500 to 900°C. The apparatus for making these measurements is described by showing detailed construction. Although the data are not conclusive, they do indicate that the applicable absorption coefficients for both boric oxide and flinak are low and that radiant transmission through short sections of either pure material approaches 100%. The equivalent thermal conductivity for radiation varies directly with the thickness of the liquid layer. (N.W.R.)

19055 MAGNETOHYDRODYNAMIC LUBRICATION FLOW BETWEEN PARALLEL ROTATING DISKS. W. F. Hughes and R. A. Elco (Carnegie Inst. of Tech., Pittsburgh). J. Fluid Mech., 13: 21-32(May 1962).

The motion of an electrically conducting, incompressible, viscous fluid in the presence of a magnetic field is analyzed for flow between two parallel disks, one of which rotates at a constant angular velocity. The specific application to liquid metal lubrication in thrust bearings is considered. The two field configurations discussed are: an axial magnetic field with a radial current and a radial magnetic field with an axial current. It is shown that the load capacity of the bearing is dependent on the MHD interactions in the fluid and that the frictional torque on the rotor can be made zero for both field configurations by supplying electrical energy through the electrodes to the fluid. (auth)

19056 PREDICTION OF BURNOUT HEAT FLUX OF FORCED CONVECTION. Itaru Michiyoshi and Ryūichi Matsumoto (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 4: 224-31(Apr. 1962). (In English)

A method for predicting burnout heat flux of forced convective flow of water in a channel is described. The pressure range covered is between atmospheric pressure and 2000 psia, Reynolds number of flow between 7×10^3 and 5×10^5, length to diameter ratio of flow channel between 7 and 160, and various channel geometries. The method calculates the heat flux q_A at point A where the non-boiling forced convection heat-transfer characteristic curve might intersect with the natural convection-bulk characteristic curve if the boiling did not occur. A correlation between the ratio of burnout heat flux q_{BO} to heat flux q_A and Reynolds number is presented for practical purposes. (auth)

19057 ISENTROPIC GAS-FLOW. Tables and Correction Nomograms. František Bauer and Jindřich Marek. Prague, Publishing House of the Czechoslovak Academy of Sciences, 1961. 643p. $32.50 (Plenum Press, Inc., New York).

Methods for solving the isentropic flow of perfect gas with respect to the variability of the specific heats with temperature are presented. This method consists in correcting values of the fundamental functions and permits a substantial widening of their use. Tables of the fundamental functions of isentropic flow, which are valid for many technically important gases, are constructed and presented along with correction nomograms for dry air. (N.W.R.)

Instrumentation

Refer also to abstracts 19951, 19955, and 19968.

19058 (AD-263521) DEVELOPMENT OF NEUTRON-GAMMA RAY INSTRUMENTATION FOR LUNAR SURFACE COMPOSITION ANALYSIS. Semiannual Technical Report, January 1–June 30, 1961. E. Frank Martina and Edward R. Carlson (Aerospace Corp. Space Physics Lab., El Segundo, Calif.). Contract AF04(647)-594. 20p. (TDR-594(1244-02)TR-1)

An analysis technique capable of determining the nature and relative abundance of constituent elements at remote places, such as the lunar and planetary surfaces, is described. A brief theoretical discussion is followed by details on accomplishments to date in developing a prototype instrument for analysis of the lunar surface. (auth)

19059 (AD-265759) RESEARCH INVESTIGATION OF P-I-N ELECTRON JUNCTION DETECTORS. Interim Engineering Report No. 1, July 1, 1961 through September 30, 1961. (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Oct. 1961. Contract NObsr 85511. 9p.

The counting performance of p-i-n solid-state detectors for beta and gamma radiation was partially established. Tests with several uncalibrated isotopes and with a calibrated Co^{60} source indicated good response to both beta and gamma radiation at several energy levels for a wide range of count rates. The detector obeys the inverse square law and has an efficiency of about 3.6% when counting photons from Co^{60}. (auth)

19060 (AE-67) ON THE CALIBRATION AND ACCURACY OF THE GUINIER CAMERA FOR THE DETERMINATION OF INTERPLANAR SPACINGS. Manfred Moeller (Aktiebolaget Atomenergi, Stockholm). Mar. 1962. 21p.

The accuracy of the Guinier camera is evaluated for determining lattice parameters without calibration substances. Sources of error are considered and criteria for camera accuracy are discussed. It is concluded that a

camera constant substantially independent of the Bragg angle can be determined most accurately for any film with the aid of a few calibration lines diffracted to high Bragg angles if for an optimal line measuring accuracy of ±0.01 mm the sample is not allowed to deviate by more than ±0.05 mm from the focussing cylinder defined by the film position. (J.R.D.)

19061 (ANL-6531) THE DESIGN AND CONSTRUCTION OF THERMAL FLOWMETERS. R. W. Kessie (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-Eng-38. 12p.

A thermal flowmeter was designed and tested which will measure a wide range of flow rates for highly corrosive gases. Response to flow rate changes is fast. The parameters for changing the size and response to the flowmeter were evaluated. (auth)

19062 (APEX-912) CONTROLS AND INSTRUMENTATION. Comprehensive Technical Report, General Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. T. A. DeRosier—H. D. Clapper, ed. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). May 16, 1962. Contracts AF33(600)-38062 and AT(11-1)-171. 132p.

A compilation of reports on the more worthwhile technology and hardware development efforts for the control system of an aircraft nuclear power plant is presented. However, the major emphasis is on the development efforts applied to the reactor control rather than to the turbomachinery control. The philosophy of control, analysis and simulation techniques, and some of the systems that were proposed and investigated are discussed. Power plant simulation is described. The various actuator designs that were considered as possible solutions to such problems as high temperature, poison rods located behind the turbomachinery compressor, and backup safety actuators are also described. Much of the electrical component effort was directed toward obtaining equipment capable of operating in the nuclear and temperature environment of a supersonic aircraft while meeting established reliability, size, and weight requirements. The efforts on the sensors, primarily for measurement of temperature and neutron power level, that were necessary for the control of the reactor are discussed. (auth)

19063 (BNL-711) NANOSECOND COUNTER CIRCUIT MANUAL. R. Sugarman, F. C. Merritt, and W. A. Higinbotham (Brookhaven National Lab., Upton, N. Y.). Feb. 1962. Contract [AT(30-2)-Gen-16]. 41p.

A manual is presented for use by experimenters in high-energy physics who will use the fast logic circuits at Brookhaven and for those who will maintain the circuits. Construction and shielding, nanocard interconnections, transistor limiters, discriminators, coincidence circuit, fanout, scaler, scaler-driver, four-fold fan-in nanocard, time-to-pulse-height converter, single-shot pulser, and gate circuit are described. (M.C.G.)

19064 (CERN-62-10) THE H.P.D. LOGIC. A DIGITAL SYSTEM FOR THE TRANSMISSION OF MEASUREMENTS FROM BUBBLE CHAMBER PHOTOGRAPHS DIRECTLY INTO A COMPUTER. Tor Lingjaerde (European Organization for Nuclear Research, Geneva). Feb. 16, 1962. 59p.

The CERN flying spot digitizer known as the Hough Powell Device (H.P.D.) is described. Particular emphasis is placed on development of H.P.D. electronic components. Photographs and diagrams of the device are included. (J.R.D.)

19065 (CERN-62-11) THEORY OF AUTOMATIC TRACK-FOLLOWING FOR INSTRUMENTS FOR THE MEASUREMENT OF BUBBLE CHAMBER PHOTOGRAPHS. M. de Baets (European Organization for Nuclear Research, Geneva). Feb. 16, 1962. 28p.

Consideration is given to partial automation of conventional apparatus for track following. Notes are presented to provide the necessary information for use in choosing the most suitable system of automatic regulation and optimizing design either by calculation and adjustment or by analog computing, depending on the complexity of the envisaged servomechanism. (J.R.D.)

19066 (CRDC-1083) SILVER-109 AS AN EPI-THERMAL INDEX MONITOR FOR USE WITH COBALT FLUX MONITORS. R. G. Hart, C. B. Bigham, and F. C. Miller (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1962. 25p. (AECL-1503)

The epi-thermal contribution to the activation of a Co flux monitor can be conveniently measured by placing a Ag monitor near the Co monitor and comparing the relative activations with the relative activations in a known spectrum. Values of the Westcott epi-thermal index parameter, $r\sqrt{T/T_0}$ can be determined to an accuracy of ±5.2% at the 0.05 level and ±3.8% at the 0.10 level. These accuracies are sufficient to reduce the error contributed to the effective Co cross section by the epi-thermal component to less than 0.5%. The value determined for S_0Ag^{109} was 18.74 ± 0.08 relative to a value of 17.0 for Au^{197} or 18.74 ± 0.5 including the uncertainty in S_0Au^{197}. This value is in good agreement with the value of 19.0 ± 1.4 calculated from the resonance parameters. (auth)

19067 (CREL-1061) USE OF A C.D.C. 100 CHANNEL KICKSORTER AS A MULTIPLE SCALER. R. A. McNaught (Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.). Feb. 1962. 35p. (AECL-1478)

Two methods of using a C.D.C. 100-channel kicksorter as a multiple scaler in sequential counting operations are described. The first method requires kicksorter modification and provides 100 scalers each with a 65536-count storage capacity with a dead time of 45 to 60 μsec. The second method requires the same modification to the kicksorter and an additional unit which scales down the input signals producing a dead time of 2 μsec and a storage capacity of 6, 553, and 600 in each scaler. (J.R.D.)

19068 (DC-55-6-12) CALIBRATION OF FUEL ELEMENT THERMOCOUPLES. R. H. Clark (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 27, 1955. Contract AT(11-1)-171. 19p.

Tests in the thermocouple rig showed that fuel plate thermocouples of the type that will be used on the HTRE H-2 core will have an error of approximately 76°F if the a-c welder is used, 58°F if the d-c welder is used, and 82°F if the a-c welder is used with the wires not flattened. (auth)

19069 (DC-59-2-721) P-102 ION CHAMBER IRRADIATION IN THE MTR. G. St. Leger-Barter (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho). Feb. 23, 1959. Contract AT(11-1)-171. 28p.

A summary is given of tests on the P-102 type ion chambers in the MTR in December, 1958. The chambers tested gave consistent ion chamber type characteristic curves. The leakage current to ground was also investigated. The characteristic curves obtained in the tests are presented. The test was marred by the uncompensated ion chamber developing an internal short circuit during the early part of the test. (auth)

19070 (DC-59-12-222) OPERATION OF FISSION CHAMBERS AT 350°C. J. E. Schroeder and R. L. Treinen

(General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 28, 1959. Contract AT(11-1)-171. 16p.

The results of testing fission chambers at an ambient temperature of 350°C are presented. It is shown that fission chambers can be satisfactorily operated at such temperatures with only a minor loss of sensitivity. In addition the chamber noise level was not observed to increase significantly for the chambers tested. (auth)

19071 (DP-704) A MAGNETIC MIXER FOR LIQUIDS. Gretchen B. Alewine and Carlton K. Nicholson (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 1962. Contract AT(07-2)-1. 8p.

A simple, laboratory-size mixing apparatus was developed to mix multiphase liquid samples in sealed glass tubes. The apparatus is compact and is designed for remote operation in high levels of radiation. (auth)

19072 (EURAEC-246) SOLID STATE NEUTRON DETECTOR. Quarterly Report No. 5, October 1–December 31, 1961. (Brussels. Centre d'Étude de l'Énergie Nucléaire). Work performed under United States–Euratom Joint Research and Development Program. Contract 079-61-10RDB. 15p.

Studies were continued on radiation damage to SiC and diodes. Measurements of Hall effect and resistivity were performed on a number of p-type crystals of SiC in a temperature range between 300 and 1300°K. An activation energy of 0.31 ev for the acceptor impurities was deduced from the temperature dependence of free hole concentration. The Hall mobility decreased from about 40 $cm^2 v^{-1} sec^{-1}$ at 300°K to 2.7 $cm^2 v^{-1} sec^{-1}$ at 1000°K. The scattering mechanism for holes in SiC was studied. The Hall mobility cure was explained by three scattering mechanisms: scattering by optical phonons, acoustical phonons, and charged impurity centers. (auth)

19073 (HW-SA-2539) CALIBRATION OF VENTURIS FOR HIGH PRESSURE, HIGH TEMPERATURE WATER SERVICE. M. E. Shockley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 13, 1962. Contract [AT(45-1)-1350]. 16p.

The equations and discharge coefficients required for measuring the wide range of flows experienced in the 189-D high-pressure, high-temperature heat transfer facility are defined. Measurements of flow were made with venturis whose combined flow ranges were 1 to 125 gpm. The calibration of each venturi was made by weighing the amount of water which passed through the venturi in a given length of time. A graph of flow versus specific volume is presented for each venturi. A venturi equation was used in derivation of the formula for obtaining the ratio of the Reynolds number to the discharge coefficient and for calculating the discharge coefficient. This calibration technique and method of determining discharge coefficients during operation yielded flow measurements to an accuracy of ±½%. (M.C.G.)

19074 (NARF-62-4T) NUCLEAR MEASUREMENT TECHNIQUES FOR RADIATION-EFFECTS ENVIRONMENTAL TESTING. W. E. Dungan and J. H. Lewis (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 31, 1962. Contract AF33(657)-7201. 124p. (FZK-9-175)

Methods and techniques employed at General Dynamics/Fort Worth for characterizing radiation-effects environments are discussed. Procedures for dosimetry planning and execution, together with detailed examples for specific application, are included. Included also are reaction data, calibration factors, and flux calculations for thermal-, resonance-, and fast-neutron foil-type detectors. Typical neutron spectra and integrals, gamma spectra, decay schemes, statistical analysis of data, pulse shapes, and nonnuclear (temperature) parametric effects on gamma systems are illustrated. Thirty-three references pertinent to the documented information are cited. Decay schemes of useful neutron detectors and detailed procedures for IBM reduction of foil data are also given. (auth)

19075 (TID-15659) A 2 Pi LIQUID SCINTILLATION COUNTER FOR DETERMINING THE RADIOACTIVITY OF LARGE SAMPLES INCLUDING MAN AND ANIMALS. J. E. Christian, W. V. Kessler, and P. L. Ziemer (Purdue Univ., Lafayette, Ind.). [1960?]. Contract AT(11-1)-876. 18p.

The design and operating characteristics of a 2 pi large volume liquid scintillation counter are described. The counter is used for measuring natural and tracer amounts of added radioactivity in people, animals, and large samples. The detector tank, containing more than 90 gal of scintillator solution, is mounted in a horizontal position and is shielded by 6 in. of steel. The tank has a semicircular center well in which the samples are placed. This well is 72 in. long and has a 20 in. diameter. Six 16 in. diameter photomultiplier tubes provide good light collection efficiency. A conveyor system permits rapid and convenient loading and unloading of samples. The counter is currently being used to count Cs^{137} and K^{40} simultaneously. The counting efficiency for a Cs^{137} point source is 30.5% with an average background of 13,300 cpm, and the counting efficiency for a 3.32 kg potassium chloride standard is 18.6% with an average background of 8,600 cpm. The natural K^{40} level in humans can be determined with an error of less than 2.5% in a counting time of 4 min. (auth)

19076 (TID-15686) A PROPORTIONAL COUNTER EFFICIENCY STUDY FOR THE CONTINUOUS BETA SPECTRA OF S^{35} AND Pm^{147} (thesis). Ernest Frederich Blase (Vanderbilt Univ., Nashville). June 1955. 46p.

The efficiency of a proportional counter for the detection of high-energy electrons was studied. The continuous beta spectra of S^{35} and Pm^{147} were investigated. Count rate-energy studies were made at various gas pressures with and without an applied magnetic field for two different source positions. The principle of proportional counters and the effects of varying pressure and using a magnetic field are discussed. The apparatus and experimental procedure are described. To detect what improvement in efficiency existed between any two spectra, areas under comparable portions of the spectra plotted on 4 cycle semilog paper were compared. It was found that either an increase in pressure or the application of a magnetic field increased the efficiency of the counter for higher energy particles. (M.C.G.)

19077 (TID-15695) FREQUENCY MODULATED MULTI-CHANNEL PULSE HEIGHT ANALYZER (thesis). James Clinton Couchman (Vanderbilt Univ., Nashville). May 1955. 52p.

Characteristics of pulse-height analyzers for analysis of energies of neutrons produced by a Cockcroft-Walton accelerator were studied. Arguments for the multichannel analyzer and typical examples are presented. The circuitry involved in pulse height analyzers is described. A study was made of problems in the development of a frequency-modulated multichannel analyzer in which pulse height is converted to frequency deviation in a sweep frequency oscillator and the amount of frequency shift analyzed by a series of frequency band pass filters. (M.C.G.)

19078 (TID-15696) THE SCINTILLATION COUNTER AS A MEANS OF DETERMINING LOW ENERGY X-RAY MASS ABSORPTION COEFFICIENTS (thesis). Robert Lewis French (Vanderbilt Univ., Nashville). June 1955. 27p.

A method is described for evaluating x-ray mass absorption coefficients using a high-intensity x-ray source, a crystal x-ray spectrometer, and a scintillation spectrometer. Results obtained for Al and Cu at 13.2 to 40.0 kev are included. Observations were made at 14 different wave lengths for Al and at 11 for Cu. (J.R.D.)

19079 (TID-15701) A TERPHENYL–BORON LIQUID NEUTRON DETECTOR (thesis). Wallace H. Campbell (Vanderbilt Univ., Nashville). 1953. 52p.

The development of a neutron detector with a toluene solution of terphenyl as a liquid scintillator is described. The capabilities and responses of available scintillation counter equipment are outlined. Preparation of the scintillation liquid and construction of a suitable containing cell are discussed. Graphs are presented of the response of the system. (M.C.G.)

19080 (CEA-tr-A-1035) NOUVEAUX APPAREILS DE MESURES APPLIQUES A LA PHYSIQUE NUCLEAIRE. (New Measurement Apparatus Applied to Nuclear Physics). Scholz. Translated into French from Technik (Berlin), 16: No. 3, 222-4(1961). 8p.

Two new radiation detection devices are described. One, using a scintillation spectrometer, is designed not only to detect the radiation of a substance and to measure its intensity, but also to determine the energy distribution. The characteristics of this radiation detector are given. A personnel monitor, capable of measuring a radiation dose from 0.01 to 500 mr/hr, is also described. (J.S.R.)

19081 ELECTRONIC SCANNER FOR A SINGLE CHANNEL PULSE AMPLITUDE ANALYZER. A. Tanarro and A. Rincón (Junta de Energia Nuclear, Madrid). Anales real soc. españ. fís. y quím. (Madrid), Ser. A, 57: 303-8 (Nov.-Dec. 1961). (In Spanish)

A continuous electronic automatic scanner for a single-channel pulse amplitude analyzer is described. Scanning voltages of 60 v in amplitude and 10, 30, and 60 min in duration are obtained with a linearity better than 1%. A complex gamma spectrum obtained with the instrument is given. (auth)

19082 IONIZATION CHAMBERS FOR REACTOR CONTROL. Joachim Linhardt (Technische Hochschule, Munich). Arch. tech. Messen, Lfg. 311, 275-6(Dec. 1961). (In German)

In addition to proportional counters, neutron-sensitive ionization chambers are also used for the detection of neutrons in the reactor and for the measurement of the power rise, both for the control and the safety monitoring of reactors. Ionization chambers are described which vary from each other in construction and operation. Pulse ionization chambers and current ionization chambers are considered. (J.S.R.)

19083 FAST ANALYSIS OF GAMMA RADIATION IN AIR AND RAIN WATER WITH THE IMPULSE SPECTROSCOPE. M. Honrath-Barkhausen and F. H. Rinn (Siemens & Halske A. G., Karlsruhe, Ger.). Atomkernenergie, 7: 131-3(Apr. 1962). (In German)

The advantage of an impulse spectroscope as compared to the single-channel discriminator is its ability of recording spectra of radiation in a much shorter period of time. It requires about the same amount of time as a multichannel spectrometer. By way of an example, analysis of filters after the passage of air and of rain water samples is shown in which radioactive fission products from nuclear weapon tests were found. (auth)

19084 OBSERVATIONS ON DOSIMETRY OF A LARGE-SURFACE RADIATION SOURCE. Th. Tuchscheerer (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Atomkernenergie, 7: 134-9(Apr. 1962). (In German)

An approved disposition for volumetric intensity distribution was used for radiation from a big-surface x-ray anode. By superposition of radiation for this anode a sufficiently small reference plane $\Delta f(df)$ can be found for which the Lambert cos-law is valid. In comparing calculated and measured intensity values it is shown that this disposition allows determination of the surface dosages of moved samples within permissible errors of measurement. The same comparison allows the portion of scattering radiation, which appears in the lateral regions of the measuring panel, to be determined. (auth)

19085 A NEW METHOD FOR THE REDUCTION OF ALPHA-RAY BACKGROUND IN A GRIDDED IONIZATION CHAMBER. Tadayoshi Doke (St. Paul's Univ., Tokyo). Can. J. Phys., 40: 607-21(May 1962).

By making use of grid pulses in a double-gridded ionization chamber, it was attempted to eliminate the background pulses caused by the alpha particles emitted from electrodes other than the cathode. Operating conditions for the reductions of the background in this method were investigated analytically. Using the double-gridded chamber of a parallel-plate type with a maximum sample area of 80 cm^2 for alpha particles of 9 Mev, a background counting rate of one count per hour was achieved in the energy region from 3.5 to 9 Mev. It was found that an insulator like polyethylene could be used as a sample base with a good resolution for very weak activity. Spectra of weak alpha activities were measured by the present method. For the purpose of practical applications, the construction of a cylindrical double-gridded chamber is proposed. (auth)

19086 DETECTION OF NUCLEAR RADIATIONS WITH THE AID OF GOLD–SILICON SURFACE-BARRIER COUNTERS OF VERY HIGH RESISTIVITY. André Coche and Paul Siffert (Centre de Recherches Nucléaires, Strasbourg). Compt. rend., 254: 1261-3(Feb. 12, 1962). (In French)

Gold–silicon n surface barrier counters with resistivity equal to 10,000 Ω-cm were constructed. Their characteristics for the detection of α particles and electrons are indicated. (tr-auth)

19087 CALCULATION OF THE EFFECTIVE ANODE LENGTH AND OF THE SENSITIVE VOLUME OF GEIGER-MUELLER COUNTERS WITH GLASS WALLS AND EXTERNAL CONDUCTING COATING. André Birot and Daniel Blanc (Faculté des Sciences, Toulouse, France). Compt. rend., 254: 1978-9(Mar. 12, 1962). (In French)

The distribution of the potential at the interior of the detector was obtained on an I.B.M. 650 computer by a successive numerical iteration method. Thus the exact form of the sensitive volume and the relative importance of various parameters were determined. Certain experimental properties were confirmed. (tr-auth)

19088 CONTINUOUS γ-RAY THICKNESS GAGE OPERATING WITH A SCINTILLATION COUNTER. László Barta, János Kakas, Mihály Nagy, and Károly Varga. Energia és Atomtech., 14: 570-5(Dec. 1961). (In Hungarian)

The first radioactive thickness gages made use of β-active sources connected to an ionization chamber. The Radioisotope Laboratory of the Csepel Iron & Metal Works developed a new, continuous instrument based on the use of γ sources, used for controlling the wall thickness of oxygen

cylinders fabricated at the plant. The measurements are based on the well-known exponential attenuation law. The device includes a radiation source, a detector, and a measuring instrument. Several source materials were tested, including Tl^{204}, Tm^{170}, Ir^{192}, Cs^{137}, and Co^{60}; the detecting system consists of a NaI(Tl) scintillation counter with a 2-stage photomultiplier. The source, fastened at the end of a rod, is inserted into the rotating metallic cylinder while the detecting unit is inserted into the rotating metallic cylinder while the detecting unit is placed on a table at a distance of about 30 cm. Care is taken to eliminate mechanical vibration of the systems during the measurements; the line voltage is also stabilized. The instrument was found to be very useful for continuous automatic process control, for sorting goods according to wall thickness, and for recording highest and lowest values. The errors did not exceed 0.8%. (TTT)

19089 SCATTERED RADIATION FROM LARGE Co^{60} CALIBRATING SOURCES. L. Costrell (National Bureau of Standards, Washington, D. C.). Health Phys., 8: No. 3, 261-72(June 1962).

Radiation beams from multicurie Co^{60} sources are widely used for instrument calibration and for radiation treatment. It is often assumed for purposes of analysis that such beams contain only the 1.17 and 1.33 Mev γ-rays. However, it is recognized that this assumption is not strictly valid because of the energy degradation due to Compton scattering in the source material and the source collimator. A scintillation spectrometer with a 5-in.-diameter by 4-in.-long sodium iodide crystal was used to determine the amount and energy of the scattered radiation as well as its variation with source dimensions and collimator geometry. Since the sources currently in common use have appreciable mass, source scattering is a far greater contributor of degraded radiation than is the collimator. Thus for multicurie sources, minimization of scatter involves primarily an increase in specific activity. The scattered intensity from the sources investigated ranges from 3.3 to 14.6% of the intensity in the primary beam. Quantitative data are presented. (auth)

19090 PROPORTIONAL COUNTERS WITH INDUSTRIAL APPARATUS. A. F. Vinogradov, L. I. Chigarev, and S. P. Rybak. Izmeritel'naya Tekh., No. 5, 49-52(1961).

Applications of Russian proportional counters of different types, which are combined with industrial counting and recording apparatus, are described. (P.C.H.)

19091 THE CONTINUOUS MEASUREMENT OF THERMAL-NEUTRON FLUX INTENSITY IN HIGH-POWER NUCLEAR REACTORS. W. R. Loosemore and J. A. Dennis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Brit. Nuclear Energy Soc., 1: 109-18(Apr. 1962).

The problem of measuring continuously the thermal-neutron flux intensity in high-power reactors at temperatures up to 500°C is considered, and it is concluded that the mean-current ionization chamber provides the best solution. The development of a suitable chamber is described, which is made from stainless steel and has a gas filling of xenon. When the electrodes are coated with uranium oxide (U_3O_8) containing 0.48 mg of U^{235}, the current sensitivity is 7×10^{-17} amp/n/cm^2/sec, and at a neutron flux intensity of 10^{13} n/cm^2/sec the equilibrium residual current measured in a graphite-moderated reactor is 0.6% of the total output. Life tests were carried out successfully to a total neutron dose of 3×10^{20} n/cm^2. At a flux intensity of 10^{14} n/cm^2/sec a chamber with uncoated titanium electrodes has the same fraction of residual current as one containing U^{235}, and is preferred as it is not subject to depletion effects. (auth)

19092 TRANSFER OF NBS X-RAY BEAM CALIBRATIONS. J. S. Pruitt, A. Allisy, G. Joyet, W. Pohlit, M. Tubiana, and C. Zupančič. J. Research Natl. Bur. Standards, 66C: 107-12(Apr.-June 1962).

A large aluminum ionization chamber is calibrated in the U. S. to determine the total amount of energy transported by a bremsstrahlung beam. This chamber is used to transfer this absolute calibration to similar ionization chambers in Europe. The transfers are made by direct experimental comparison of the chamber sensitivities in the betatron x-ray beams in these laboratories. The transferred calibrations are corrected for differences in x-ray beam size and filtration. (auth)

19093 FILAMENT CURRENT CONTROLLER FOR MS5 MASS SPECTROMETER. J. D. Milne, A. W. Pryor, and R. N. Whittem (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). J. Sci. Instr., 39: 237-8(May 1962).

A transistorized circuit is described for controlling the filament current in a surface ionization type mass spectrometer. The circuit works on the principle that variations in the filament current cause the light output from a small torch bulb to vary and these light variations are detected by a phototransistor and amplified to control the filament current. The controller maintains a constant rms current. (N.W.R.)

19094 SIMPLE PROCEDURE FOR STRETCHING CIRCULAR MEMBRANES. H. Figdor (International Atomic Energy Agency's Lab., Seibersdorf, Austria). J. Sci. Instr., 39: 241(May 1962).

A simple method for fixing very thin (down to 1 mg cm^{-2}) and tightly stretched membranes, as used for extrapolation chamber diaphragms and Geiger-Mueller windows, is described. The method produces very tightly stretched membranes free of all wrinkles. The method has the advantage of not requiring the use of grease, and membranes can be tightly applied in a few minutes. The method uses a special device with grooves around it and the device is a circular form. (N.W.R.)

19095 MODIFICATION OF THE RESOLUTION TIME OF GEIGER-MUELLER TUBES BY MONOVIBRATOR CIRCUITS. H. W. Schulze and M. Leistner (Institut für Angewandte Radioaktivität, Leipzig). Kernenergie, 5: 35-41(Jan. 1962). (In German)

The modification of tube discharge by lowering of the tube voltage under the Geiger threshold by means of rectangular monovibrator pulses is discussed. Two characteristic forms of the modification were detected. The monovibrator pulse appears before the discharge lateral broadening begins to narrow, limiting the narrowing and shortening the resolution time. If the pulse occurs after discharge narrowing, then the ion migration is retarded and the resolution time is lengthened. Special circuits and formulas were developed for the experimental detection of this phenomenon. (tr-auth)

19096 "GRAY-WEDGE" TYPE MULTICHANNEL AMPLITUDE ANALYZER. Bálint Schlenk. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 183-94(1961). (In Hungarian)

In view of their simplicity of construction and reliability the so-called "gray-wedge" type multichannel analyzers are widely used for nuclear investigations; the darkening of the photographic plate of the instrument is used to record and to store the information received. Their way of operation is similar to that of optical gray wedges which change the intensity of the lines in the direction of one of the axes but in this case a modulating voltage is employed

to change the intensity of the electron beam within the cathode ray tube, resulting in suitable modulated lines on the screen. Experimental errors arising from the use of the instrument are due to uneven focusing sharpness at various points of the screen, the inhomogeneity of the fluorescent layer, and variation of the intensity of the electron beam within the tube as a result of changes in the input current. Great care must be taken to keep the photographic operations strictly constant. The instruments are very useful for the rapid determination of the shape and nature of spectra and the measurement of the peak energy. (TTT)

19097 A G-M COUNTER EXTINCTION CIRCUIT FOR THE ELIMINATION OF THE DEAD TIME. Béla Makranczy. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 195-202(1961). (In Hungarian)

In view of the limited life time of G-M counters filled with self-quenching gas mixtures, instruments containing gases or mixtures, not possessing self-quenching properties must also be used. Considerable progress has been made in the construction of such counters, allowing considerable reduction of the recovery time. On the basis of previous work (W. B. Mann & G. B. Parkinson, Rev. Sci. Instr., 20: 49(1949)) a novel circuit was developed; it contains a multivibrator with continuous operation suppressed by a large negative prevoltage. The operational uncertainty arising out of the dead time of the extinction circuit has been eliminated by retaining the counter's signal during the dead time, ensuring a satisfactory operation after the lapse of the dead-time period. Instruments filled with various rare gases and connected to a number of extinction circuits were tested under filled conditions. (TTT)

19098 A STEREOSCOPIC RECORDING AND EVALUATING DEVICE. József Bacsó and János Schadek. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 203-9(1961). (In Hungarian)

A stereoscopic camera was developed for taking pictures and for projecting them on a suitable screen thus facilitating the study of nuclear processes or other phenomena in the cloud chamber. The taking of pictures is directly controlled by the cloud chamber, and the device is able to take about 350 pictures per minute. The usual distortions occurring in such systems are avoided because the same optical system is used for projecting the picture. During the study of the spatial location of a track, the center of the screen remains at the same location. The new technique made it possible to determine the angle between track of the back-scattered Li^6 and β particles in the β decay of He^6. The camera contained Tessar objectives with a focal length of 50 mm at a distance of 166.25 mm from each other. Measurement of the tracks is facilitated by placing a scale and a goniometer on the projecting screen. (TTT)

19099 STABILIZED DC HIGH VOLTAGE POWER SUPPLY USING TRANSISTOR CIRCUITS. Eiji Kaneko (Hitachi Ltd., [Japan]). Nippon Genshiryoku Gakkaishi, 4: 217-23(Apr. 1962). (In Japanese)

A stabilized d-c high voltage power supply using transistor circuits was developed. It was designed for supplying the high voltage to low voltage proportional counters of photomultipliers. The operating range is 900 to 1,500 v and 0 to 5 ma. Other characteristics are: internal noise, less than 50 mv; voltage stabilization factor, 2.4×10^{-3}; d-c incremental internal resistance, 40 to 1,000 Ω; over-all drift, less than ±0.02%/10 min. ±0.2%/1 hr, and ± 0.25%/8 hr; stabilizing time, less than 1 min; and temperature coefficient, +0.05%/°C. (auth)

19100 A PRECISION SOLENOIDAL BETA RAY SPECTROMETER. J. A. Jungerman, M. E. Gardner, C. G. Patten, and N. F. Peek (Univ. of California, Davis). Nuclear Instr. & Methods, 15: 1-14(Feb. 1962). (In English)

The design and performance of a solenoidal-type beta spectrometer are discussed. The uniform (1 in 10^4) magnetic field is measured and controlled by nuclear magnetic resonance of the proton. A mean take-off angle of 23.5° is employed with a scale factor $D = \rho p/eB = 78.8$ cm. Absolute Bρ values are given for the E, F, I, J, L, O, P, and X lines of ThB active deposit. Resolution and transmission observed are compared with theoretical values. At resolutions of 0.050%, 0.047%, 0.028%, and 0.018%, the measured transmissions are 0.36%, 0.32%, 0.11%, and 0.040% for the I line of ThB. (auth)

19101 AN ANALYTIC TREATMENT FOR SCINTILLATION COUNTER TIME RESOLUTION FUNCTIONS. M. A. El-Wahab and J. V. Kane (Brookhaven National Lab., Upton, N. Y.). Nuclear Instr. & Methods, 15: 15-22(Feb. 1962). (In English)

Expressions are given for time response functions of scintillation counters employing a mathematical model to introduce various time spreads. It is shown that for exponential time spreads these functions are obtained in closed analytic form. The statistics are treated exactly, and numerical values are given for several cases of interest. (auth)

19102 PROBLEMS POSED BY THE STUDY OF BUBBLE CHAMBER PHOTOGRAPHS WITH THE CHAMBER OPERATING IN AN ELECTRON BEAM. R. Weill and E. Malamud (E.P.U.L., Lausanne, Switzerland). Nuclear Instr. & Methods, 15: 23-30(Feb. 1962). (In English)

A bubble chamber is used to study the interactions of high energy electrons. The determination of mean free path and mean primary energy presents special problems due to the straggling of energy loss of the electrons when passing through matter. A monoenergetic beam will have a spectrum of energies after passing through an entrance window. In the chamber there will be an observed sagitta spectrum resulting from the superposition of magnetic curvature, multiple scattering, and distortion. To keep the spread in the primary energy small, a cutoff of maximum sagitta is imposed on the primary tracks. This cutoff necessitates the introduction of a statistical weight applied to each event according to its position in the chamber. The statistical weight, mean energy, and energy dispersion are calculated for general operating conditions, and the dependence of these quantities on initial energy, entrance window thickness, magnetic field, and distortion is shown. Some comparisons with experimental measurements are made. (auth)

19103 A SIMPLE AND ACCURATE METHOD FOR CALIBRATING NANOSECOND TIME-TO-PULSE-HEIGHT CONVERTERS. R. L. Graham (Atomic Energy of Canada Ltd., Chalk River, Ont.), J. S. Geiger, R. E. Bell, and R. Barton. Nuclear Instr. & Methods, 15: 40-4(Feb. 1962). (In English)

A simple method for calibrating timesorters is described which has an absolute accuracy of <1%. Fast-rising ($\sim 10^{-9}$ sec) pulses are fed into a junction point of a 10-meter-long air-cored delay line and travel to the ends of the transmission line which are coupled to the limiting circuits of the timesorter. The input junction position, x, can be set at any desired point along the 10-meter length. The propagation velocity, v, is 99% of the velocity of light, c. Thus, a change in junction position of Δx results in a change in the relative arrival times of the pulses at the

limiters of $\Delta t = 2\Delta x(0.99c)^{-1}$. The mechanical features of the air-cored transmission line are described, and factors affecting the accuracy of the method are discussed. (auth)

19104 EFFICIENCY OF SECONDARY EMISSION MONITORS FOR ELECTRON BEAMS. V. J. VanHuyse and R. E. Van de Vijver (Rijksuniversiteit, Ghent). Nuclear Instr. & Methods, 15: 63-8(Feb. 1962). (In English)

The efficiency of secondary emission monitors for electron beams was calculated. Starting from the Möller cross section, the secondary electrons are considered as creators of tertiary electrons of which those coming out of the monitor foils lead to a first term $F_1(E)$ that is a function of the energy E of the primary electron, but practically independent of the foil thickness ξ. A second term $F_2(E,\xi)$, depending on energy and thickness of the foil, is obtained by considering the secondary electrons that leave the foil. From 10 Mev on, the efficiency can be written as $G(\xi) + \alpha \ln E$, G being a function of ξ only and α being a constant. Comparison with experiment in the energy regions 0.5 to 3.5 Mev, 15 to 40 Mev, and 100 to 600 Mev leads to a fairly good agreement. (auth)

19105 AN INTEGRAL-BIAS SUMMING SPECTROMETER FOR GAMMA–GAMMA COINCIDENCE AND ANGULAR CORRELATION STUDIES. J. Kantele and R. W. Fink (Univ. of Arkansas, Fayetteville). Nuclear Instr. & Methods, 15: 69-73(Feb. 1962). (In English)

A new type of scintillation coincidence spectrometer is designed which sums pulses from scintillation events occurring simultaneously in two NaI(Tl) crystals, integral-bias discriminator outputs being used in coincidence or in anticoincidence with sum-pulses, to select wanted coincidences. This "sum-peak spectrometer" has a better efficiency and resolution than an ordinary coincidence spectrometer, from which it can be obtained by an easy modification to give additional information on coincidence relations of gamma-rays. As no pulse-height selector windows are involved, the performance of the spectrometer is insensitive to minor electronic drifts, which also makes this system especially useful in angular correlation studies. Here in some cases it permits a simultaneous measurement of several angular correlation functions. It also offers the possibility of using a known gamma cascade as an internal monitor which reduces uncertainties due to geometrical and other effects. (auth)

19106 A FAST-NEUTRON ACTIVATION DETECTOR FOR 14-Mev PULSED NEUTRON SOURCES. Lawrence Ruby and Joseph B. Rechen (Univ. of California, Berkeley). Nuclear Instr. & Methods, 15: 74-6(Feb. 1962). (UCRL-9861(Rev.)) (In English)

A fast-neutron activation detector is described in which the gamma rays resulting from the decay of Pb^{207m} are observed in a plastic scintillator. The Pb^{207m} is produced by fast-neutron activation of a lead shield which surrounds the scintillator and photomultiplier. Following a 20-msec delay from the neutron pulse, the Pb^{207m} activity is observed for 2.40 sec. A source of Ba^{133} is used to check the gain stability of the detection system. The detector is observed to have higher sensitivity than a standard silver activation detector. (auth)

19107 INVESTIGATION OF THERMIONIC VALVES FOR PREAMPLIFIERS. H. J. Dubrau (Technische Universität, Dresden). Nuclear Instr. & Methods, 15: 77-86(Feb. 1962). (In German)

The properties of thermionic tubes for use in low noise preamplifiers, the choice of the operating conditions, the dependence of preamplifier sensitivity on these conditions, and the circuitry are discussed. It is shown that certain tubes are most suitable for time constants from 0.5 to 5 μsec. (auth)

19108 THE DIGISCAT—A DIGITALLY CONTROLLED DEVICE FOR THE MEASUREMENT OF MULTIPLE SCATTERING IN NUCLEAR EMULSIONS. M. J. B. Duff (University Coll., London). Nuclear Instr. & Methods, 15: 87-94(Feb. 1962). (In English)

The Digiscat is a digitally controlled device which provides a semi-automatic method for the measurement of multiple scattering of particle tracks in nuclear emulsions. The operations required for the measurement of multiple scattering by constant cell and constant sagitta methods are carried out automatically each time the operator sets a crosswire onto the track and presses a footswitch. The Digiscat provides a printed list of y coordinates, their second differences, and the sum of the moduli of the second differences. A punched tape output is also available. (auth)

19109 SPARK COUNTER AS A LIGHT PULSER FOR PHOTOTUBE TESTING. S. L. Gupta and N. K. Saha (Univ. of Delhi). Nuclear Instr. & Methods, 15: 95-100 (Feb. 1962). (In English)

The spark counter used as a fast electrical pulse generator for testing fast coincidence circuits is very useful also as a light pulser utilizing the spark as a source of light; the electrical pulse generated at the same time as the light pulse can be taken as a time reference for it. Transit-time measurements of some multiplier phototubes using the above light pulses and the electrical pulses have been carried out by a coincidence method, instead of the conventional method of fast oscilloscopes. The transit time for the RCA-5819 and RCA-IP21 is estimated to be (19.5 ± 0.3)ns and (16.8 ± 0.3)ns, respectively. (auth)

19110 A 300 WATT 100 Mc/s R.F. OSCILLATOR. Matti K. Salomaa (Massachusetts Inst. of Tech., Cambridge). Nuclear Instr. & Methods, 15: 113-14(Feb. 1962). (In English)

Radiofrequency ion sources in general give rise to a beam modulated by the exciting frequency. It has been found that the degree of modulation can be reduced to negligible proportions by using an exciting frequency of 100 Mc/s or greater in conjunction with an axial magnetic field on the plasma of a few hundred kilogauss. The oscillator designed for this purpose is shown. It has operated reliably for over 1 yr. without the need for servicing, with a power output of 300 w. It is capable of a maximum output of 400 w. (L.T.W.)

19111 DUAL-COUNT TRANSFER SYSTEM FOR DEKATRON. K. S. Kuchela (Atomic Energy Establishment, Trombay, India). Nuclear Instr. & Methods, 15: 117-18 (Feb. 1962). (In English)

Dual-count transfer from the plates of a flip-flop is frequently employed for improving the reliability and counting capability of a ring counter. This type of drive can be used for certain types of Dekatrons. The forty electrode Dekatron, Erricsson type GC10D, though generally used as a single pulse counting tube, can be adopted for this purpose. One set of twenty alternate electrodes is used as cathodes and the other as the guide or transfer electrodes. When associated with the flip-flop drive, twenty stable states are obtained. (L.T.W.)

19112 INSTRUMENTATION IN ATOMIC ENERGY–1962. Denis Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). Nuclear Power, 7: No. 74, 50-4(June 1962).

The most important developments in nuclear instrumentation in 1962 are reviewed and discussed. Instruments of interest are those used for reactors, industrial plants, and radiation detection. (N.W.R.)

19113 HEALTH PHYSICS INSTRUMENTS FOR FACTORIES. D. E. Barnes (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Power, 7: No. 74, 55-8(June 1962).

The characteristics of radiation detection instruments are discussed with respect to the advantages and limitations to certain applications in industry. These instruments are also discussed with respect to regulations made for users of radiation-producing equipment. (N.W.R.)

19114 AN IN-PILE FISSION COUNTER FOR REACTOR COMMISSIONING. A. L. Gray (Plessey Nucleonics Ltd., Northampton, Eng.). M. W. Jervis, and J. Shaw. Nuclear Power, 7: No. 74, 62-4(June 1962).

An in-pile fission counter was used in the commissioning of the Berkeley reactor in order to show that low-level flux can be satisfactorily measured during initial start-up without using an active source. An adequate indication of neutron flux at total shutdown for varying air pressure conditions in the pressure vessel was also obtained. (N.W.R.)

19115 TEST RIG INSTRUMENTATION. [PART] I. D. Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). Nuclear Power, 7: No. 74, 68-70(June 1962).

The requirements necessary for simulating reactor conditions in a test rig are discussed. The discussions are centered around illustrations of control rod mechanisms, gas monitoring equipment, and in-pile test rigs. (N.W.R.)

19116 LITHIUM–IODIDE SCINTILLATORS FOR FAST-NEUTRON DETECTION. Harold L. Overton (Univ. of Houston, Tex.). Nucleonics, 20: No. 6, 78-80(June 1962).

The efficiency and performance of europium-activated lithium iodide scintillators for fast-neutron detection are examined for the range 1 to 10-Mev common to radium–beryllium and polonium–beryllium sources. The results indicate that the scintillators make excellent fast-neutron detectors. These crystals may be useful for fast-neutron-flux oil-well logging, the only limitation being electronics that can be put down-hole in a logging tool. The results are presented for cadmium and polystyrene covered crystals and unshielded crystals. (N.W.R.)

19117 THE DEVELOPMENT OF A NEUTRON GUIDE AT THE FRM REACTOR. Josef Christ and Tasso Springer (Technische Hochschule, Munich). Nukleonik, 4: 23-5 (Feb. 1962). (In German)

A neutron guide depending on total-reflection is described which was installed at the FRM Reactor. It is used to guide subthermal neutrons to the reactor surface where transmission and scattering experiments can be performed under very favorable background conditions. (tr-auth)

19118 THE X-RAY FLUORESCENT SPECTROSCOPY WITH RADIOACTIVE ISOTOPES. W. Kuehn (Institut der Isotopen-Studiengesellschaft, Karlsruhe, Ger.). Nukleonik, 4: 30-3(Feb. 1962). (In German)

The practical application of x-ray fluorescent spectroscopy with radioisotopes as radiation sources and with pulse-height spectrometers and proportional counters in place of analyzer crystals has found increasing utilization in recent years. Some observations on the possible energy resolution of this method are reported. (tr-auth)

19119 CALCULATION OF THE SENSITIVITY AND RESOLUTION OF A COMPTON COINCIDENCE SCINTILLATION SPECTROMETER. Hans Dieter Dahmen and Alfred Schaarschmidt (Universität, Frankfurt am Main). Nukleonik, 4: 33-9(Feb. 1962). (In German)

With the assumption of a rectangular scintillation crystal, an accurate expression for the sensitivity of a Compton coincidence scintillation spectrometer was derived, and it was evaluated numerically in the energy range from 100 kev to 3 Mev for crystals with the dimensions 1.27 cm^3 × 3.8 cm and 11.4 cm^3 × 2.5 cm, a spectrometer angle of 150°, and a crystal distance of 10 cm. The numerical evaluation permits also a representation of the "geometric" line form limited by the geometric arrangement of the crystals. The possible energy resolution of the apparatus in the energy range studied is discussed. (tr-auth)

19120 GEOMETRIC ERRORS IN COINCIDENCE COUNTING APPARATUS. Heinz Buchholz (Hahn-Meitner-Institut für Kernforschung, Berlin). Nukleonik, 4: 56-7 (Feb. 1962). (In German)

The geometric errors in coincidence counting apparatus are considered in the case of a homogeneous activity distribution for a measurement apparatus consisting of two scintillation counters. The results show that scintillation counters have a site-dependent recording probability which must be considered in the operation of coincidence stages with scintillation counters. The geometric correction can deviate considerably from 1 in this type of apparatus. In order to obtain a small correction, preference must be given to a rotation-symmetrical flat path for the recording probability. (J.S.R.)

19121 LOW-LEVEL DOSE MEASUREMENT WITH NEWLY DEVELOPED FLUORO GLASS DOSIMETER AND THE ENERGY DEPENDENCE. Ryosuke Yokota, Saburo Nakajima, and Yasuo Uesugi (Tokyo Shibaura Electric Co.). Radioisotopes (Tokyo), 10: 387-94(Dec. 1961). (In Japanese)

Silver-activated phosphate glass which contains a large amount of Li and a small amount of B was developed. This glass is less energy dependent, and the fading is small. A fluorometer was developed from this glass with linear response from 10 mr up to 3000 r for γ-rays. By using the glass, 8 × 8 × 4.7 mm^3, the integrated dose 30 mr for γ-rays can be measured with the accuracy of ±10%. This glass is practically independent with the direction of the incident radiation. By using the glass of 1 mmϕ × 6 mm length rod, depth dose measurement and field mapping can be accomplished very conveniently. (auth)

19122 HAND AND FOOT CLOTH MONITOR FOR LOW ENERGY BETA RAYS. Iwao Otsuka and Katsuyuki Nakai. Radioisotopes (Tokyo), 10: 395-401(Dec. 1961). (In Japanese)

A hand and foot cloth monitor for low energy beta rays using semi-cylindrical side window counter tubes was made, and counting efficiency and arrangement of the counter tubes are discussed. Dimensions of the counter tube are 182 mm in length and 45 mm in diameter, and there are five mica windows (25 mm in diameter and thickness is 1 ~ 3 mg/cm^2) on the side. The arrangement of the counter tubes is the same as that of an ordinary hand and foot cloth monitor. That is, two groups (four tubes) of the counter tubes are used for each of the hand and one group (two tubes) is used for each of the feet. Measurements of the efficiency of each group for beta and alpha rays were carried out by using the RaDEF standard source (12.7 mm), U_3O_8 (120 mm square) source, and scaler. Results show that the most desirable distance from the counter window of each group to the source where counting efficiency is not varied by locality and area of the source is 30 mm. In this geometry, counting efficiency is 9^{+4}_{-2}% (for 2π geometry). This efficiency is about twice that of counting efficiency of the normal hand and foot monitor using thin wall beta-gamma counter tubes. (auth)

19123 SENSITIZATION OF THE DIRECT DARKENING PHENOMENON IN PHOTOGRAPHIC EMULSIONS AND APPLICATION TO DETERMINATION OF THE GAMMA RAY DOSE. Yoshitada Tomoda. Repts. Govt. Chem. Ind. Research Inst., Tokyo, 57: 69-75(Feb. 1962). (In Japanese)

A technique for the sensitization of the direct darkening phenomenon is developed and applied to the determination of gamma dosage. Positive movie film is treated with solutions such as metallic salts, sulfur compounds, nitrogen compounds, or a few organic reducing agents. The film is immersed in the pending solution 5 minutes at 20°C, before exposing to light, and dried quickly. This treatment increases the sensitiveness of the direct darkening phenomenon ten times or more when one utilizes the following solutions: silver nitrate (0.1 to 0.5%), sodium sulfite (0.5 to 1.0%), sodium nitride (1.5 to 15%), sodium nitrite (1.0 to 3.0%), triethanolamine (1.0 to 3.0%), genol (0.3 to 3.0%), or hydroquinone (1.0 to 5.0%). The direct darkening phenomenon was observed in emulsions exposed to cobalt-60 gamma sources; in this case the sensitization of the emulsion was due to the aforesaid treatment. The positive film with this treatment is able to detect radiation of the order of 10^3r; and when this film is utilized for radiography, one is able to detect radiation of 10^4r. (N.W.R.)

19124 OPERATION OF A BAYARD-ALPERT IONIZATION GAUGE. H. F. Winters, D. R. Denison, and D. G. Bills (Washington State Univ., Pullman). Rev. Sci. Instr., 33: 520-3(May 1962).

The conditions existing in a Bayard-Alpert gage and the effect of varying these conditions are reviewed. It is shown that several accounts of nonlinearity in gage operation are due to variation in these conditions during the test and to any intrinsic nonlinearity in the gage itself. Furthermore, it is shown that if pumping effects and conductances are taken into account, good agreement is obtained between pressure measurements made in different regions of a system containing a single gas type with gages operating at various emission currents. In addition, it is shown that many problems are substantially reduced by the simple expedient of operating the gage at reduced electron emission and filament temperature. (auth)

19125 DETECTION EFFICIENCY OF PLASTIC SCINTILLATOR FOR NEUTRON ENERGIES 4 TO 76 Mev. Clyde E. Wiegand, Tom Elioff, William R. Johnson, Leonard B. Auerbach, Joseph Lach, and Thomas Ypsilantis (Univ. of California, Berkeley). Rev. Sci. Instr. 33: 526-9(May 1962). (UCRL-9986)

The neutron detection efficiency of plastic scintillator counters 15 cm thick has been determined for neutron energies from 4 to 76 Mev. Neutrons in this energy were obtained by scattering a 205-Mev neutron beam from a hydrogen target. A proton-range telescope selected in the forward-scattered protons from the n-p reaction, thus monitoring the flux of monoenergetic neutrons scattered in a prescribed direction. Near 10 Mev the efficiency is 30%, and it slowly decreased to 20% at 76 Mev. (auth)

19126 NEW EMISSION X-RAY MICROSCOPE. Y. Yoneda (Kyushu Univ., Fukuoka). Rev. Sci. Instr., 33: 529-32(May 1962).

A new x-ray microscope described uses x rays emitted by substances under electron bombardment. A pinhole formed by four knife edges is used for the projection. The purpose of this microscope is similar to that of the scanning electron microscope. The resolving power of about 0.45 μ was obtained by a comparatively simple apparatus. The construction, operation, resolution, and contrast of photographs obtained with the microscope are discussed, and, for comparison, examples of photographs are shown together with conventional optical micrographs. (auth)

19127 CYLINDRICAL SPARK CHAMBER. M. A. Wahlig, A. Buffington, D. H. Frisch, D. A. Hill, and L. Sodickson (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 33: 539-41(May 1962).

A spark chamber consisting of eight coaxial cylindrical gaps around a liquid hydrogen target has been built and used. The sparks are viewed by a single camera looking axially up into the chamber. Stereo information is provided in the same view by reflections of the sparks from tilted mirrors at the top of the chamber. (auth)

19128 A SWEEP MARKER. J. Grunzweig und U. Galil (Israel Inst. of Tech., Haifa). Rev. Sci. Instr., 33: 555-6 (May 1962).

In spectroscopy, when using single-pen recorders, there frequently arises the problem of marking on the records the magnitude of the independent variable $\underline{x}$. For example, in mass spectrometers or magnetic resonance spectrometers, the spectrum (the dependent variable $\underline{y}$) is often recorded by means of a single-channel, free running recorder, as functions of $\underline{x}$, in this case the magnetic field H_0. A new, simple, and comparatively inexpensive circuit for this purpose is described. (L.T.W.)

19129 INCREASE OF PULSE HEIGHT IN A PROPORTIONAL COUNTER BY MEANS OF A RADIAL THERMAL GRADIENT. T. Nagatani and Y. Sakaki (Nagoya Univ., Japan). Rev. Sci. Instr., 33: 556-7(May 1962).

A gas-flow proportional counter, containing 90% Ar–10% methane, showed a pulse-height increase by a factor of about ten when the central wire was heated to 100°C. The resolution was impaired slightly (less than 3%). There was no detectable loss of counting efficiency. (L.T.W.)

19130 PRESSURE MEASUREMENTS ABOVE 1 μ USING COMMERCIAL IONIZATION GAUGES. R. Buser and J. J. Sullivan (U. S. Army Signal Research and Development Lab., Fort Monmouth, N. J.). Rev. Sci. Instr., 33: 562-3(May 1962).

The rectification action of the gage tube was used to extend the high-pressure limit of the Bayard-Alpert ionization gage, which normally cannot operate above ~1μ pressure. (L.T.W.)

19131 BERYLLIUM FOIL MONITOR FOR EXTERNAL PROTON BEAM. Clifford E. Swartz (Brookhaven National Lab., Upton, N. Y.) and Paul Feldman. Rev. Sci. Instr., 33: 565-6(May 1962). (BNL-5977)

The apparatus described exposes a beryllium foil to the proton beam and then rotates it to a counter where the short-lived radioactivity is measured. This technique completely changes the beam density saturation problem inherent in most other monitors. (L.T.W.)

19132 DOPING OF CRYSTALS BY ION BOMBARDMENT TO PRODUCE SOLID STATE DETECTORS. Torsten Alvaeger and Niels J. Hansen (Argonne National Lab., Ill.). Rev. Sci. Instr., 33: 567(May 1962).

Ion bombardment was used to produce silicon charged particle detectors because of two advantages over diffusion methods: the quantity of the desired impurity introduced can be precisely controlled by monitoring the ion beam current, and the undesirable impurities can be avoided; further, if the ions are accelerated to only very low energies, the junction will be shallow, and owing to the discrete range of the ions, the depth will be well-defined. The resulting detector will have a very thin window, or dead layer, and, for sufficiently high impurity con-

centration, the thickness of the window will be independent of the bias voltage applied to the detector. Preliminary results indicate that this method permits construction of detectors that have an energy resolution comparable to that obtained with diffused devices. (L.T.W.)

19133 ELECTRON PARAMAGNETIC RESONANCE APPARATUS OPERATING AT LIQUID He^3 TEMPERATURES. M. Abkowitz and A. Honig (Syracuse Univ., N. Y.). Rev. Sci. Instr., 33: 568-9(May 1962).

A K-band electron paramagnetic resonance apparatus is described which operates at a steady-state temperature of 0.48°K using continuously-cycled He^3. Operation over a duration of several hours at 0.30°K has been obtained by forming a very small pool of liquid He^3 in the cold chamber and pumping on it in the absence of reinjection of the condensed He^3. (L.T.W.)

19134 SIMPLIFIED TECHNIQUE FOR POSITIONING SMALL DIAMETER X-RAY BEAMS ON SPECIMENS FOR BACK REFLECTION ANALYSIS. L. C. Michels and C. M. Wayman (Univ. of Illinois, Urbana). Rev. Sci. Instr., 33: 572-3(May 1962).

A very rapid method for x-ray beam positioning having a positioning accuracy of 10 μ or better is described. This method utilizes a light beam rather than an x-ray beam for locating the fiducial reference. (L.T.W.)

19135 GAMMA-RAY ATTENUATION FACTORS FOR ANGULAR CORRELATION AND ANGULAR DISTRIBUTION MEASUREMENTS. J. A. Mansfield and L. Schecter (Oregon State Univ., Corvallis). Rev. Sci. Instr., 33: 574(May 1962).

The correction factors of Stanford and Rivers (Rev. Sci. Instr. 30: 719(1959)) concerning gamma-ray angular distribution measurements done with 1.0- by 1.5-in. NaI cylindrical scintillation crystals were investigated for gamma-ray energies down to 0.1 Mev. Agreement with theory is quite good even where the theoretical function varies considerably with energy. (L.T.W.)

19136 SUPPLEMENT TO OUR WORK "TRACKS OF FAST ELECTRONS." Dietrich Harder, Gerl Harigel, and Klaus Schultze (Max-Planck-Institut für Physik und Astrophysik, Munich and Universität, Wurzburg, Ger.) Strahlentherapie, 117: 579-83(Apr. 1962). (In German)

The transfer of data concerning fast electron tracks from a bubble chamber filled with propane to the conditions in the living tissue is possible, if the initial energy of the electrons is changed. The formulae for change of energy and range are reported. Moreover, the different influence of the scattering at the small and broad radiation beam is shown using photographs of bubble chambers. (auth)

19137 TO THE THEORY OF THE SECTOR MAGNETIC SPECTROGRAPH WHOSE FIELD IS HOMOGENEOUS AND BOUNDARIES ARE STRAIGHT LINES. V. R. Saulit. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 37-55(1961). (In Russian)

The equation of the focal curve for a homogeneous sector-shaped magnetic field, whose sharply defined boundaries are straight lines, was found. An analytical expression for dispersion and aberration along this focal curve was obtained. The case in which the source is within the field and the focusing is realized by means of one boundary of this field was investigated. It is shown that by giving the aberration, choosing the parameters of instruments in some definite way, and using the first order focusing it is possible to get larger aperture in comparison to the second-order focusing. The analytical expression for the total transverse aberration was obtained. (auth)

19138 EQUIPMENT MEASURING ($\beta\gamma$)-CORRELATION BY REGISTRATION OF CIRCULAR POLARIZATION OF γ-QUANTA. I. V. Gadzhokov, A. A. Petushkov, and I. V. Estulin. Vestnik Moskov. Univ., Ser. III, No. 6, 76-82 (1961). (In Russian)

An automatic installation for β-γ correlations in recording circular polarization of γ quanta is described. The design is given of the autocommutation block and of the fast-acting pulse amplitude analyzer. (tr-auth)

19139 NEW SCHEMES FOR MASS SPECTROMETERS. V. M. Kelman and I. V. Rodnikova (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 269-78(Mar. 1962). (In Russian)

A design is given of a mass spectrometer with a two-dimensional magnetic electrostatic prism and telescopic system as components replacing deflecting condensers. (R.V.J.)

19140 ELECTROSTATIC PRISMATICAL ANALYSER OF CHARGED PARTICLE ENERGY. V. M. Kelman and I. V. Rodnikova (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 279-86(Mar. 1962). (In Russian)

An electrostatic prism identical to an ordinary optical prism is designed as a component of an electrostatic charged particle analyzer. (R.V.J.)

19141 MICROMINIATURIZATION. PROCEEDINGS OF THE AGARD CONFERENCE, OSLO, JULY 24-26, 1961. G. W. A. Dummer, ed. New York, Pergamon Press, 1962. 364p. (AGARDograph 57). $15.00.

Twenty-four papers are included; three are in French. Information is presented on three main systems of microminiaturization devices: micromodules, microcircuits, and solid circuits. The relative merits of various concepts of microminiaturization are discussed in regards to the application of such systems to miniature electronic components and equipment. (N.W.R.)

19142 NUCLEAR MEASURING INSTRUMENTS. TECHNICAL INFORMATION. Warsaw, Biuro Urzadzen Techniki Jadrowej, [1962]. 298p.

The various types of nuclear measuring instruments are described. Information is given on the purpose of each instrument, use, characteristics, and measuring ranges. The instruments are separated into the following classes: electronic, industrial isotope, and radiochemical. (N.W.R.)

19143 IMPROVEMENTS IN OR RELATING TO FISSION CHAMBERS. Roy Charles Hollick, Derek Barnes, John Erskine Sanders, and Frederick Wade (to United Kingdom Atomic Energy Authority). British Patent 895,759. May 9, 1962.

A fission chamber for use, e.g., in examining the flux conditions in different regions of a reactor core, is designed for use at high temperatures. The chamber comprises a tube having a chamber region at one end and a support region extending away from the chamber region, a central electrode insulatedly mounted within the chamber region, a connecting wire within the support region, and a layer of fissile material formed between the electrode and the tube. The tube is filled with Xe or Xe–Ar, since Xe lowers the pressure required for constant count-rate conditions. (D.L.C.)

19144 APPARATUS FOR STABILISING MAGNETIC FIELDS. Sidney Arthur Stuart (to United Kingdom Atomic Energy Authority). British Patent 897,153. May 23, 1962.

An apparatus is designed for stabilizing a magnetic field to an accuracy on the order of 1 part in 10^6. The apparatus comprises a coil mounted in the field, d-c supply means for the coil, restoring torque means for the coil, an oscillator

coil magnetically coupled to the coil, a-c supply means having a constant-frequency a-c output for the oscillator coil, means for comparing the phases of the a-c output at the supply means and at the oscillator coil, and servo-controller means actuated by the phase comparator output to vary the current in the electromagnet to keep the field constant. (D.L.C.)

19145 IMPROVEMENTS IN OR RELATING TO PREDETERMINED COUNTER SYSTEMS. Tage Johannes Rasmussen and Hans Christian Sorensen (to Atomenergikommissionen). British Patent 897,347. May 23, 1962.

A predetermined counter system using decade tubes is designed to deliver control pulses at counting numbers containing one of the preselected digits and no other digits than 0. For example, if the preselected digits are 1, 2, and 5, the recording of 1, 2, 5, 10, 20, 50, 100, 200, 500, and so on will cause the system to deliver a control pulse. The system may be used with advantage in equipment for measuring radioactive decay. (D.L.C.)

19146 AREA RADIATION MONITOR. F. W. Manning, S. E. Groothuis, J. H. Lykins, and D. M. Papke (to U. S. Atomic Energy Commission). U. S. Patent 3,038,997. June 12, 1962.

An improved area radiation dose monitor is designed which is adapted to compensate continuously for background radiation below a threshold dose rate and to give warning when the dose integral of the dose rate of an above-threshold radiation excursion exceeds a selected value. This is accomplished by providing means for continuously charging an ionization chamber. The chamber provides a first current proportional to the incident radiation dose rate. Means are provided for generating a second current including means for nulling out the first current with the second current at all values of the first current corresponding to dose rates below a selected threshold dose rate value. The second current has a maximum value corresponding to that of the first current at the threshold dose rate. The excess of the first current over the second current, which occurs above the threshold, is integrated and an alarm is given at a selected integrated value of the excess corresponding to a selected radiation dose. (AEC)

19147 ERROR COMPENSATOR FOR A POSITION TRANSDUCER. A. H. Fowler (to U. S. Atomic Energy Commission). U. S. Patent 3,039,032. June 12, 1962.

A device is designed for eliminating the effect of lead-screw errors in positioning machines in which linear motion of a slide is effected from rotary motion of a lead-screw. This is accomplished by providing a corrector cam mounted on the slide, a cam follower, and a transducer housing rotatable by the follower to compensate for all the reproducible errors in the transducer signal which can be related to the slide position. The transducer has an inner part which is movable with respect to the transducer housing. The transducer inner part is coupled to the means for rotating the leadscrew such that relative movement between this part and its housing will provide an output signal proportional to the position of the slide. The corrector cam and its follower perform the compensation by changing the angular position of the transducer housing by an amount that is a function of the slide position and the error at that position. (AEC)

Materials Testing

19148 (ANL-6279) PROGRESS REPORT ON NEUTRON RADIOGRAPHY. H. Berger and W. J. McGonnagle (Argonne National Lab., Ill.). Feb. 1962. Contract W-31-109-eng-38. 32p.

The potential advantages of neutron radiography as an inspection method are discussed along with a historical review and discussions of neutron sources and detectors. The results of the current investigation of neutron-image detectors are discussed in regard to photographic speed, relative neutron-gamma response, and resolution comparisons. Two neutron-image detecting methods are discussed. In one, the direct-exposure method, both the converter screens and the film are exposed to the neutron beam together. The other method, the transfer method, makes use of a radioactive, image-carrying screen, which is transferred to photographic film after the neutron exposure is completed. The direct-exposure method results in increased speed, but has the disadvantages that the film also responds to any gamma radiation in the imaging beam and that, in most cases, improved image resolution can be obtained with the transfer method. Reference is given to several application possibilities. (auth)

19149 (NP-11650) INVESTIGATION OF HALL EFFECT DEVICES FOR FLAW DETECTION IN METALS. J. Rossnick and H. Sipler (Frankford Arsenal. Pitman-Dunn Lab., Philadelphia). Mar. 1962. 34p. (R-1616)

Hall generator instrumentation and special test fixtures were employed for the detection of flaws and measurement of flaw depth in ferrous and nonferrous metals. Magnetic leakage field distribution was measured in tubular steel specimens containing artificial surface flaws from 0.004 to 0.126 in. depth. Field distribution was measured with respect to vertical and horizontal components of both field intensity and field gradient. Under the given test conditions, it was possible to estimate flaw depth from 0.017 to 0.126 in. with an accuracy of ±5%. (auth)

19150 (WADD-TR-61-91(Pt.II)) ULTRASONIC METHODS FOR NONDESTRUCTIVE EVALUATION OF CERAMIC COATING. K. E. Feith and W. E. Lawrie (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 28, 1962. Contract AF33(616)-6396. 50p.

Investigations into the use of ultrasonic techniques to determine the strength and integrity of ceramic-metal bonds are described. An acoustic image converter system was used successfully to obtain a television type display of $^1/_{32}$ in. diameter laminar defects in a zirconium oxide–inconel bond. The measured defect thickness varied between 300 and 500 microinches or about a factor of three greater than the average large grain in the coating material. Schlieren optical and acoustic lens techniques were used to visually investigate detailed properties of ultrasonic fields and the interaction of ultrasonic energy with a solid. The theory of Rayleigh waves was reviewed to provide a framework for experimental integrity determinations of ceramic coatings. (auth)

19151 NEW TECHNIQUE AND APPLICATION OF BETATRON RADIOGRAPHY ON HEAVY WELDS. K. Fink and J. Woitschach (Phoenix-Rheinrohr A. G. Duesseldorf). Brit. Welding J., 9: 220-6(Apr. 1962).

Owing to the high energy and intensity of betatron radiation, it is possible to test welds in thick-walled pressure vessels in economic exposure times and with high image quality. Techniques and examples of practical radiographic work are given. (auth)

19152 GAMMA DEFECTOSCOPY. R. Fischer. Feingerätetechnik, 10: 498-9(Nov. 1961).

Detection of defects such as cracks and holes by nondestructive testing of cast iron and steel parts up to 150 mm wall thickness by gamma-transmission using Co^{60} and Ir^{192} as radiation source, is described. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

GEOLOGY, MINERALOGY, AND METEOROLOGY

19153 (A/AC.82/G/L.709) METHODE D'ETUDE DE LA CONTAMINATION DES SOLS EN PLACE PAR LES RADIOELEMENTS. (Technique for Study of the Radioactive Contamination of Soils In Situ). J. Bourrier (France. Centre de Recherches et d'Expérimentation de Génie Rural, Antony), P. Bovard and A. Grauby (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). Apr. 21, 1960. 68p. (BTGR-48-2)

A study was made to determine if the Vergiere method, which is now used for the study of soils to be irrigated, could be used for determining contamination of soils in situ by fall-out or by radioactive adsorption. The principle of the Vergiere method is that all measurements of various magnitudes are made with a cube with side dimensions of 10 cm, cut from the soil and transported to the laboratory encased in paraffin on its four vertical faces. The method was used in preliminary experiments and conclusions are reported. The humidity of the soil sample was determined directly and the importance of this measurement was shown. (J.S.R.)

19154 (AFCRL-1038) DENSITY OF A NEUTRAL EXOSPHERE DERIVED FROM THE BOLTZMANN EQUATION. Technical Report No. 230. M. Fibich and S. F. Singer (Maryland. Univ., College Park). Oct. 1961. Contract AF19(604)-3861. 10p. (AD-266808)

It is shown that the density of a planetary exosphere can be derived from the Boltzmann equation, provided the equation is modified to take into account the escape component. The solution was obtained through a perturbation method; the zeroth order solution is the barometric formula, which applies when escape is negligible. The solution gives only the total density (ballistic plus bound orbits); the kinetic approach used by Öpik and Singer gives the separate components. (auth)

19155 (NP-11389) EL BERILO EN LA REPUBLICA ARGENTINA. INFORME NO. 60. (Beryl in the Republic of Argentina. Report No. 60). Victorio Angelelli (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1961. 48p.

As an introduction to a description of Be ore deposits in Argentina, a general survey is given of beryl ore deposits, the characteristics of these deposits, the world production of Be, and the utilization of Be in the United States. From explorations in Argentina it was determined that there are beryl deposits in the form of pegmatites, principally in the mountains of Cordoba and of San Luis. Because of the characteristics of these deposits, it is almost impossible to define the Be reserves. (J.S.R.)

19156 (RME-4514) RECONNAISSANCE FOR URANIUM IN THE OLMOS DISTRICT, NORTHERN PERU. Justin B. Moses and Cesar Rangel Z. (Division of Raw Materials, AEC and Peru. Junta de Control de Energia Atomica, Lima). Oct. 1957. 17p.

In 1957 lithologic studies, a radiometric survey, and general geologic mapping in the Olmos district of northern Peru were conducted in search of favorable host rocks for uranium. This district lies in the Cordillera Occidental, and includes small portions of the departments of Piura, Cajamarca, and Lambayeque. The rocks studied included Paleozoic schists, Triassic and Jurassic sediments and volcanics, and Cretaceous sediments, which were intruded by igneous rocks of the dacite-quartz diorite and andesite-diorite clans. The region has undergone several stages of subsidence, uplift with associated folding and faulting, and erosion, resulting in a broad faulted anticline and two major unconformities. Two major joint patterns are present, trending northeast-southwest and northwest-southeast. There is some indication that mineralizing solutions may have passed through the northeast-southwest joints, but none of the rocks examined is considered favorable for uranium occurrence. (auth)

19157 (RME-4515) RECONNAISSANCE FOR URANIUM IN THE HUALLANCA DISTRICT, DOS DE MAYO PROVINCE, DEPARTMENT OF HUANUCO, PERU. Justin B. Moses and Victor Jordán O. (Division of Raw Materials, AEC and Peru. Junta de Control de Energia Atomica, Lima). Nov. 1957. 18p.

In 1957 stratigraphic studies and radiometric surveys were made in the Huallanca district, Dos de Mayo Province, Department of Huánuco, Peru. No radioactivity anomalies were detected in the Cretaceous rocks examined. A stronger continental environment may have prevailed, however, in the areas to the north, south, and east. (auth)

19158 (TEI-782) FREQUENCY OF EARTHQUAKES FOR SELECTED AREAS IN THE WESTERN UNITED STATES FOR THE PERIOD 1945–59. W. S. Twenhofel, R. A. Black, and D. F. Balsinger (Geological Survey, Washington, D. C.). Feb. 1961. 40p.

Data are presented on the frequency of earthquakes for the states of California, Nevada, Washington, Montana, Wyoming, Utah, Arizona, and New Mexico for the period from 1945 to 1959. Each earthquake for the states in question was listed according to location, date, and magnitude. The earthquake epicenters are plotted on maps. (C.H.)

19159 (TEI-796) PRELIMINARY EVALUATION OF THE SEISMICITY, GEOLOGY, AND HYDROLOGY OF THE NORTHERN SAND SPRINGS RANGE, CHURCHILL COUNTY, NEVADA, AS A POSSIBLE SITE FOR PROJECT SHOAL. William S. Twenhofel, John E. Moore, and Rudolph A. Black (Geological Survey, Washington, D. C.). July 1961. 26p.

An evaluation was made of the northern Sand Springs Range, Churchill County, Nevada, as a possible site for Project Shoal, in terms of seismicity, climate, topography, geology, and hydrology. Preliminary data from library research apd a brief field examination of the area are presented. Technical criteria for a suitable site for the Shoal experiment are listed. (M.C.G.)

19160 (TEI-808) GROUND-WATER TEST WELL B, NEVADA TEST SITE, NYE COUNTY, NEVADA. A Summary of Lithologic Data, Aquifer Tests, and Well Construction. John E. Moore and Murray S. Garber (Geological Survey, Washington, D. C.). Apr. 1962. 44p.

Ground-water test well B was drilled to a depth of 1675 ft with rotary and cable-tool drilling equipment. It penetrated 548 ft of alluvium of Quaternary and Tertiary (?) age, 222 ft of lake deposits of Quaternary and Tertiary (?) age, and 905 ft of tuff of Tertiary age. The static water level is about 1511 ft below the land surface or 2418 ft above sea level. Water occurs in densely welded tuff and is yielded chiefly from fractures. In two tests by bailing the aquifer yielded 6 and 8 gallons per minute to the well, and on this

basis the specific capacity of the well was less than 0.16 gallon per minute per foot of drawdown. The tuff contains zeolite, clay, quartz, cristobalite, feldspar, mica, and calcite. The lake deposits contain essentially these same minerals but differ in having more varieties of clay minerals. Laboratory measurements of tuff samples showed that the coefficients of permeability of the welded and the partially welded tuffs are less than 0.03 gallon per day per square foot, but that of the vitric-pumiceous tuff ranges from 0.3 to 2 gallons per day per square foot. Geophysical logs, a summary of contract costs, detailed descriptions of drilling, casing, cementing, and hydraulic testing operations, x-ray mineralogical analyses, physical property analyses, and a detailed lithologic log are presented. (auth)

19161 ATMOSPHERIC WAVES FROM NUCLEAR EXPLOSIONS. William L. Donn and Maurice Ewing (Columbia Univ., New York). J. Geophys. Research, 67: 1855-66(May 1962).

Records of acoustic-gravity waves generated by multimegaton nuclear explosions which occurred between 1952 and 1961 are described. Atmospheric pressures recorded by sensitive instruments widely distributed over the earth are the basis of the analysis. The records begin with a dispersive wave train in which period decreases from a maximum of about 9 minutes to a minimum as low as 0.5 minute. Short-period waves which appear in the latter parts of the records and which often overlap the dispersive train are explained as belonging to higher modes. The method initiated by seismologists in the study of earthquake surface waves is used to compute group-velocity dispersion curves for the dispersive wave trains. These are compared with preliminary theoretical models for different thermal structures of the atmosphere. The empirical dispersion curves indicate that the atmospheric structure controlling the dispersion of these waves varies significantly along different profiles and probably along different segments of the same profile. The curves which best approach world-wide average atmospheric conditions seem to be those corresponding to meridional paths or those whose paths cause cancellation of the varying zonal winds. (auth)

19162 ATMOSPHERIC OZONE. John L. Kroening and Edward P. Ney (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 1867-75(May 1962).

Measurements of ground-level ozone and the vertical distribution of ozone are given. Ground measurements show a strong diurnal variation coincident with the formation of a temperature inversion. Adsorption, storage, and desorption of ozone at the earth's surface are discussed, along with decomposition. The strength of the ozone sink at the earth's surface is determined to be approximately 6×10^{10} atoms of ozone per cm^2 per sec. A latitudinal and seasonal variation in the sink strength at the earth's surface is suggested in relation to the latitudinal and seasonal variation of total ozone. The vertical diffusive transport of ozone is considered, and evidence is given for the direct transport of air between the stratosphere and the troposphere via thin stable laminae. Data are presented indicating that the tropopause is not a barrier to the direct exchange of matter between troposphere and stratosphere. An explanation for the occurrence of secondary ozone maxima in the stratosphere is given. The production of ozone by lightning is calculated to be of the same order of magnitude as that produced by solar ultraviolet light. It is calculated that the ozone produced by a 50-megaton nuclear device amounts to about 0.1% of the total ozone in the atmosphere. (auth)

19163 THE GENERATION OF HORIZONTALLY POLARIZED SHEAR WAVES BY UNDERGROUND EXPLOSIONS. J. K. Wright and E. W. Carpenter (Atomic Weapons Research Establishment, Foulness, Essex, Eng.). J. Geophys. Research, 67: 1957-63(May 1962).

In the seismic records from underground explosions there has been a weight of experimental evidence to show the existence of horizontally polarized shear waves. An interesting problem is whether such shear waves are generated at the source or are formed as the result of conversion from other wave forms during transit. The experimental evidence for conversion is mainly negative. Theoretically it is shown that a small amount of shear wave energy near the source can become relatively more important at large distances. Possible mechanisms for the generation of shear waves are Taylor instability in a soft medium and cracking in a hard medium. Geological inhomogeneities can be important in either case. (auth)

19164 AN ANALYSIS OF CRATERING DATA FROM DESERT ALLUVIUM. M. D. Nordyke (Univ. of California, Livermore). J. Geophys. Research, 67: 1965-74(May 1962).

From the large amount of data available for explosion craters in the desert alluvium at the Nevada test site it was possible to establish very reliable relationships among charge size, depth of burst, crater radii, and crater depths. A scaling law for crater dimensions of $W^{1/3.4}$ is derived, together with an efficiency factor for nuclear explosives relative to high explosives. In addition, a curve for the dependence of crater radii and depth on the depth of burst of the explosive is given. (auth)

19165 RUBIDIUM–STRONTIUM AGE DETERMINATIONS OF MUSCOVITES AND BIOTITES FROM PEGMATITES OF THE BLUE RIDGE AND PIEDMONT. W. G. Deuser and L. F. Herzog (Pennsylvania State Univ., University Park). J. Geophys. Research, 67: 1997-2004 (May 1962).

Eighteen mica specimens from pegmatites of the Blue Ridge and Piedmont provinces yield Rb/Sr apparent ages of 250 to 510 million years (m.y.). Muscovites from the Piedmont generally appear to be younger (avg. about 285 m.y.) than those from the Blue Ridge (avg. about 315 m.y.). Highly discordant ages were found for coexisting biotite and muscovite from two Blue Ridge pegmatites; the biotite ages are about 275 m.y. while the muscovites both yield ages of 510 m.y. Loss of radiogenic Sr^{87} from the biotite seems the most likely explanation of the differences; some of this may have been gained by the muscovite, thereby raising its age. Some possible causes of discordance seem excluded; these include different crystallization times for biotite and muscovite, preferential loss of rubidium from the muscovite, original Sr^{87} abundances in the pegmatitic fluids markedly higher than 7.02%, and assimilation by the crystallizing pegmatites of country rock with an anomalously high Sr^{87} abundance. In general, previous suggestion by others that widespread metamorphism and pegmatite emplacement took place in the Blue Ridge in two periods, about 500 and 350 m.y. ago was supported; however, the ages found for the eight Piedmont samples range from 255 to 330 m.y. and do not support the idea of a single 250-m.y. event in this region. (auth)

19166 MASS SPECTROMETRIC STUDY OF THE LEAD IN CARBONACEOUS CHONDRITES. Royal R. Marshall (Universität, Bern). J. Geophys. Research, 67: 2005-15(May 1962).

Measurements of the isotopic ratios of lead from the Indarch, Murray, Mokoia, and Orgueil carbonaceous chondrites show that their leads differ only slightly from the primordial type of lead found in the Canyon Diablo iron meteorite. Formal calculation of the lead-lead ages of Murray and Mokoia yields 4.7 and 4.6×10^9 years, respectively. Empirical justification for these lead-lead ages comes from the agreement of similarly calculated ages for ordinary chondrites with those obtained by completely independent methods. There seems to be an additional small component of the radiogenic lead isotopes. The amount of this excess is comparable to that which was observed in the Holbrook chondrite. Indarch contains an excess of Pb^{207}. Either this meteorite is older (about 5.1×10^9 years), or (more likely) some variations in isotopic composition were present at the beginning of the solar system. Carbonaceous chondrites seem to have originated from chondritic material by the addition of certain elements and the loss of others. They acquired of the order of 1 to 4 ppm of primordial lead of the Canyon Diablo type. (auth)

19167 RARE GASES IN THE CHONDRITE PANTAR. C. M. Merrihue, R. O. Pepin, and J. H. Reynolds (Univ. of California, Berkeley). J. Geophys. Research, 67: 2017-21(May 1962).

Ne and He studies for the chondrite Pantar were confirmed, and measurements were extended to include Ar and Xe. The light phase of this meteorite is typical of most chondrites in its content of radiogenic He^4 and Ar^{40} and cosmogenic He^3, neon, and argon. The dark phase, in which opaque minerals outline the chondrules, is rich in primordial rare gases. Primordial xenon, exhibiting general isotopic anomalies identical to those found in carbonaceous chondrites, occurs in both phases but is 12 times more abundant in the dark phase. Radiogenic Xe^{129} from I^{129} decay occurs in both phases but is 53 times more abundant in the dark phase. The primordial gas spectrum resembles other meteorites in its He/Ne and Xe/Ar ratios. In its Ar/Ne and Ne^{20}/Ne^{22} ratios it resembles Pesyanoe and belongs to what can be loosely described as a cosmic group of gas-rich stones. (auth)

19168 ON THE PRODUCTION RATIOS OF RARE GAS ISOTOPES IN STONE METEORITES. Heinz Stauffer (Univ. of California, San Diego). J. Geophys. Research, 67: 2023-8(May 1962).

Abundances and isotopic compositions of argon, neon, and helium extracted from eight stone and four stony-iron meteorites were determined, and argon-potassium ages were calculated. The production ratios of cosmic-ray-produced isotopes were compared with the chemical composition of the samples. It was found that the ratios Ne^{21}/Ar^{38} may be predicted with an accuracy of usually better than 20% by the equation $Ne^{21}/Ar^{38} = 2.9 \times [Si] + 1.35[Al] + 6.8[Mg]/[Fe] + 16.5[Ca]$ where [Si], [Al], [Mg], [Fe], and [Ca] are the concentrations of the corresponding elements. It is concluded that the cosmogenic ratios He^3/Ne^{21}, He^3/Ar^{38}, and Ne^{21}/Ar^{38} in stone meteorites are determined essentially by the chemical composition of the samples only and that differences in shielding and possible diffusive losses are of minor importance. (auth)

19169 ABSENCE OF CARBON-14 ACTIVITY IN DOLOMITE FROM FLORIDA BAY. Kenneth S. Deffeyes and E. L. Martin (Shell Oil Co., Houston, Tex.). Science, 136: 782(June 1, 1962).

A sample of dolomite crystals concentrated from Recent carbonate sediments in Florida Bay gave a carbon-14 age greater than 35000 years. Since Recent sedimentation in Florida Bay began less than 4000 years ago, the dolomite must be derived from older rocks, and Taft's hypothesis that dolomite is forming today is incorrect. (auth)

19170 COSMOGENIC CARBON-14 IN METEORITES AND TERRESTRIAL AGES OF "FINDS" AND CRATERS. Parmatma S. Goel and Truman P. Kohman (Carnegie Inst. of Tech., Pittsburgh). Science, 136: 875-6(June 8, 1962).

Carbon-14 was measured in several stone and iron meteorites. For falls, the C^{14}/Al^{26} ratios in stones and the C^{14}/Cl^{36} ratios in irons are consistent with constant irradiation. The stone finds have radiocarbon ages of up to ≥ 21000 years. The Henbury craters are apparently ≤ 7000 and the Odessa craters ≥ 11000 years old. (auth)

19171 RAINFALL AND DEPOSITION OF STRONTIUM-90 IN CLALLAM COUNTY, WASHINGTON. Edward Hardy (Health and Safety Lab., AEC, New York) and Lyle T. Alexander. Science, 136: 881-2(June 8, 1962).

A linear relation between cumulative strontium-90 deposition and rainfall was observed from measurements made at five sites on the Olympic Peninsula. When an estimated contribution from dry deposition is subtracted from the measured total, the strontium-90 concentration in precipitation is seen to be independent of the amount of precipitation. (auth)

HEALTH AND SAFETY

19172 (AD-266007) THE WALTER REED WHOLE BODY COUNTING FACILITY. DETAILS OF CONSTRUCTION. GAMMA RADIOACTIVITY IN PEOPLE AND FOODSTUFFS, JULY 1958 TO JULY 1960. Kent T. Woodward, Charles L. Randolph, Jr., Robert van Hoek, James B. Hartgering, Harry A. Claypool, Arnold A. Manskey, Jr., and Jay J. Noble (Walter Reed Army Medical Center. Inst. of Research, Washington, D. C.). July 1960. 151p.

A facility for determining gamma activity directly in humans was constructed during 1957 at the Walter Reed Army Institute of Research. This facility includes a large NaI crystal gamma spectrometer and a 4-π liquid scintillation counter. This location was selected because of population density, and a large hospital complex ensured the use of the facility in clinical medicine and metabolic research. The experiences and techniques of whole-body counting are described. (auth)

19173 (AD-266072) RADIOLOGICAL DECONTAMINATION SWEEPER. Technical Report No. 172. Final Report. W. R. Nehlsen (Naval Civil Engineering Lab., Port Hueneme, Calif.). Oct. 18, 1961. 20p.

Three types of pavement sweepers were investigated to determine their adaptability for high-rate radiological decontamination. A runway sweeper utilizing an air nozzle pickup was found to be unadaptable. Ordinary street sweepers can perform limited services as decontamination sweepers, but are not suitable for complete development as high-rate units. A sweeper developed for Air Force decontamination needs is described which is adaptable to the task requirements. (auth)

19174 (AERE-M-1010) RADIOACTIVE FALL-OUT: SHORT-LIVED FISSION PRODUCTS FROM THE RUSSIAN NUCLEAR EXPLOSIONS OF 1961. E. M. R. Fisher, J. R. Keane, A. E. R. Toureau, and R. S. Cambray (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 22, 1962. 23p.

Short-lived fission products from the Russian nuclear explosions of 1961 were studied during the period September 1961 to March 1962. Total beta, Ba^{140}, and I^{131} activities were measured in samples of atmospheric dust, rain, and grass. The concentration of Ba^{140} in surface air at Chilton (Berks) reached a maximum value of 2.0 picocurie/kilogram of air in mid-November 1961; the Ba^{140} activity contributed ~15% of the total activity up to this time; the I^{131} activity, as measured, was more variable but until December tended toward one-half of that due to Ba^{140}. The dry deposition velocities increased to 1 cm/sec in October 1961. (auth)

19175 (ANL-6540) RADIATION PROBLEMS ASSOCIATED WITH THE HANDLING OF THE ACTINIDE ELEMENTS. Martin J. Steindler (Argonne National Lab., Ill.). Apr. 1962. Contract W-31-109-Eng-38. 39p.

The hazards connected with the handling of actinide elements are surveyed. Emphasis is placed on Th, U, Np, and Pu. It is pointed out that the chemical toxicity of the actinides is usually minor when compared with radiochemical toxicity. Inhalation and ingestion are the important routes of entry but direct injection into the blood stream through wounds also requires consideration. Special enclosures, such as glove boxes, function primarily to minimize the risk of inhalation and aid in confinement. The external hazard from actinide elements, primarily due to γ and fast neutron emission, varies considerably with the element and its source. Irradiated actinides, such as Th and Pu, usually show an increase in the external hazard from γ radiation with extent of irradiation. (C.H.)

19176 (ARCRL-6) RADIOACTIVITY IN MILK. Interim Report, December 1961. (Gt. Brit. Agricultural Research Council. Radiobiological Lab., Wantage Berks, England). Jan. 1962. 14p. (A/AC.82/G/L.762)

During the twelve weeks from September to December 1961 the average content of iodine-131 in milk throughout the country was 96 picocuries (no micro microcuries) per litre; between major regions the values ranged from 62 to 136 picocuries per litre. These levels represent from 11 to 24% of the quantity which would give rise to the annual average of 130 picocuries per litre which the Medical Research Council has considered would not cause the acceptable radiation dose to be exceeded for any age group of the population. Measurements of strontium-90 in milk are reported for the period January to June, 1961. For the twelve months ending June 1961 the countrywide average was 5.5 picocuries of strontium-90 per gram of calcium or 15% less than that for the twelve months ending December 1960. Decreasing values were observed also in the majority of special areas where localized studies are in progress. (auth)

19177 (EURAEC-167) DESIGN AND ECONOMIC STUDY OF SPENT FUEL SHIPPING. Quarterly Report No. 2, July 1 to September 30, 1961. Gerald Fisher (Stanray Corp., Chicago). Sept. 28, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-963. 6p.

Activities are described in investigations of shipment of spent radioactive fuel elements from EURATOM reactors to U. S. reprocessing plants. Shipment regulations were acquired and clarified. A conceptual cask design is about 80% complete, and a port of entry was tentatively selected. An investigation was initiated concerning freight rates and insurance requirements. (J.R.D.)

19178 (HW-67697) DETECTION LEVEL OF THE FILM BADGE SYSTEM. R. H. Wilson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Nov. 28, 1960. Contract [AT(45-1)-1350]. 4p.

Improvement in the calibration system and installation of automatic processing equipment has contributed to the over-all accuracy of the film badge system and reduction of detection level. However, the largest contribution is derived from the ability of the film emulsion to record measurable densities at lower dose levels. Previously the detection level was quoted as 40 mr at about the 95% confidence level for 502 film emulsion. A statistical study of 508 emulsion response data collected from "production" batches indicate the detection level of the film badge system is now approximately 15 mr at the 90% confidence level considering normal distribution of density-dose values for the 30 mr calibration level. With thirteen routine badge periods per year, the annual detection level is approximately 195 mr for penetrating gamma radiation. (auth)

19179 (LAMS-2660) PLUTONIUM FACILITY OPERATING PROCEDURES IN CMF-5. W. N. Miner and F. W. Schonfeld, comps. (Los Alamos Scientific Lab., N. Mex.). Nov. 1, 1961. Contract W-7405-Eng-36. 175p.

Safety regulations and operating procedures related to the various types of equipment used in the Plutonium Physical Metallurgy Group at the Los Alamos Scientific Laboratory are described in detail. Consideration of the hazards involved in working with plutonium is emphasized. A brief description of the group's activities and facilities is also included. (auth)

19180 (LAMS-2702) BETA-GAMMA RADIOACTIVITY IN ENVIRONMENTAL AIR AT LOS ALAMOS, NEW MEXICO, FOR 1961. William R. Kennedy (Los Alamos Scientific Lab., N. Mex.). Mar. 1, 1962. Contract W-7405-Eng-36. 21p.

Data are tabulated on particulate radioactivity in samples of air collected at Los Alamos during the first three quarters of 1961. The values were quite low. (C.H.)

19181 (NP-11641) PUBLIC HEALTH ASPECTS OF ENVIRONMENTAL RADIATION. N. Irving Sax and Jack J. Gabay (New York. State Dept. of Health, Albany). Nov. 15, 1960. 81p. (RSG-C1)

Preliminary results are reported for a long-range study of the effects upon populations of exposure to emanations from naturally occurring radioactive materials. A miniature community ingestion and excretion study for the ingestion of radium was carried out with ten individuals, comprising five married couples, participating. Results are reported from investigations of analytical methods, the ambient radon content of the air in homes, whole-body counting, external dose measurements, and special samples analysis. (C.H.)

19182 (PPAD-457D) DESIGN GUIDE AND RULES FOR HYDROGEN SAFETY. N. Oser, T. Bowen, K. Lande, P. J. Reardon, and M. Yearian (Princeton–Pennsylvania Accelerator, Princeton, N. J.). May 1, 1962. Contract AT(30-1)-2137. 10p.

Guidance for design criteria is presented to be used for promoting maximum safety in H handling during experiments at the Princeton-Pennsylvania Accelerator. Included are sections describing the boil-off and dumping system, pre-operating purging, ventilation, sensing equipment, ignition prevention, and experimental equipment containing H. (J.R.D.)

19183 (RME-4564) RECONNAISSANCE FOR URANIUM IN THE RIO TAMBO AREA, PROVINCE OF ISLAY, DEPARTMENT OF AREQUIPA, PERU. Justin B. Moses and Francisco Cútolo L. (Division of Raw Materials, AEC and Peru. Junta de Control de Energia Atomica, Lima). Feb. 1958. 11p.

Geologic and radiometric investigations were made in 1958 in the Río Tambo area of southern Peru. No anomalous radioactivity was detected in visibly mineralized rocks, but two very small anomalies were noted in Jurassic-Cretaceous sedimentary rocks that were not visibly mineralized. (auth)

19184 (TID-15305) SCAVENGING OF RADIOACTIVE PARTICULATE MATTER AND AEROSOLS IN CONNECTION WITH NUCLEAR REACTOR OPERATION. Final Summary Report, September 1, 1960–February 28, 1961, and time extension to January 31, 1962. Jan Rosinski (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 31, 1962. Contract AT(11-1)-578. 62p. (ARF-3184-14)

A summary is given of research on scavenging and removal of radioactive aerosols and iodine from the atmosphere of the containment vessel, prevention of aerosol formation from fuel elements, and miscellaneous problems connected with safety of operation of nuclear reactors. A chemical-physical scavenging system composed of a fine water spray and hydrolysis products of silicon tetrafluoride was adapted for possible use inside reactor containment vessels. Static and dynamic neutralization tests of corrosive hydrolysis products indicated that a less than 2M solution of NaOH should be used for this purpose. Preliminary tests were performed on suppression of aerosol formation from fuel elements. Complete or partial suppression would prevent or minimize the hazards connected with travel and deposition of a radioactive aerosol cloud released from a reactor plant under certain abnormal conditions. Aluminum oxide and colloidal silica proved to be effective scavengers for cesium and barium, respectively. On the basis of results from preliminary experiments, the most effective over-all suppressors of cesium, strontium, barium, and lanthanum are powdered copper and powdered molybdenum. Halogen collection and halogen sorption units for a specific plant were evaluated. Evaluations and recommendations were made for iodine adsorption on activated carbons; particle deposition in the containment vessel, reactor compartment, and ducts; and atmospheric dispersion from elevated stacks. (auth)

19185 (TID-15632) ENVIRONMENTAL RADIATION MONITORING QUARTERLY REPORT, FIRST QUARTER, JANUARY–MARCH 1962. (Duquesne Light Co., Shippingport, Penna.). Contract [AT(11-1)-292]. 11p.

Results of environmental radiation monitoring at the Shippingport Atomic Power Station are presented. Fall-out samples, Ohio River water, and air samples from mobile monitoring stations were analyzed. There was a substantial increase in the radioisotope content of the Ohio River. The averages of the continuous air monitor readings decreased. The fall-out sample results were comparable to those of the previous period. (M.C.G.)

19186 (TID-15683) BETA DOSIMETRY–THE POINT SOURCE FUNCTION FOR CARBON-14 (thesis). Adelbert H. Bigler (Washington. Univ., Seattle). 1957. 51p.

Dose rates of beta radiation from spherical sources in tissue were calculated and determined experimentally. The dose rate from a gas sphere was interpreted in terms of dose rate from a tissue sphere. Measurements using both a film method and an ion chamber are described. The point source function is discussed. (M.C.G.)

19187 (TID-15691) DEVELOPMENT OF POCKET CHAMBERS FOR MEASURING BETA RADIATION (thesis). Raymond M. Johnson (Oak Ridge National Lab., Tenn.). June 1957. 100p.

Submitted to Vanderbilt Univ., Nashville.

A personnel dosimeter sensitive to beta particles was developed in the shape of a pencil with conducting paper walls and a sensitive volume of the same size as that used in standard gamma chambers. Calibration was carried out using a thin walled cavity in a homogeneous water solution of a beta-emitting isotope. The average energy of electrons in water solutions of the radioisotope and the expected dose rate in an air cavity of the solutions were calculated. The beta calibration cell, pocket ionization chambers, apparatus for measuring gamma and x-ray response of pencils, isotopes used, and plating problems are described. The results of calibration of the various types of pocket chambers are summarized in graphs. There was no significant difference in the response to gamma and x rays of the pencils made with magnesium, 2S aluminum, or 24ST aluminum, but stainless steel gave large variations and was rejected. The advantages of this pencil dosimeter are outlined. Experimental confirmation was obtained for the conclusion that a large part of the dose in a thick absorber irradiated with beta rays is produced by the large number of second-

ary electrons of very low energies which arise from the degradation of the primary spectrum. (M.C.G.)

19188 (TID-15704) THE USE OF IONIZATION CHAMBERS FOR HEALTH PHYSICS SURVEY OF THE BNL 3 Bev PROTON-SYNCHROTRON (thesis). Hubert Charles Woodsun (Rochester, N. Y. Univ.). 1953. 70p.

An investigation was made of the capabilities and limitations of ionization chambers for measuring radiation dose at the BNL proton-synchrotron in terms of the Roentgen Equivalent Physical. Such problems as instrumentation, calibration, energy dependence, and saturation are discussed and both theoretical and experimental results are given. Special emphasis was placed on depth-dose studies in a tissue-equivalent phantom. (C.H.)

19189 (WT-1701) PHYSICAL DAMAGE SURVEY OF AEC TEST STRUCTURES. R. A. Cameron, Jr. and P. H. Huff (Holmes and Narver, Inc., Los Angeles). May 1961. Project 34.1 of OPERATION HARDTACK, PHASE II. Contract [AT(29-2)-20]. 123p.

A project is described for evaluating nuclear-explosion blast and thermal damage to test structures. The emphasis of the study is on structures exposed to high over-pressures and thermal radiation, however, some data are included on damage resulting from lower values. Damage data are given in terms of over-pressure and type of construction. (J.R.D.)

19190 CONTROLLING RADIATION HAZARDS IN NUCLEAR POWER PLANT. A. J. Kavale. Air Conditioning, Heating, and Ventilating, 58: 62-70(Dec. 1961).

Problems associated with the design of nuclear power plant areas are discussed with respect to ventilation to control radiation hazards. The engineering design of each area must be planned to assure continuous system operation in situations requiring maintenance and repair. This demands that the layout of nuclear plant equipment be given priority consideration in matters of design. (Public Health Eng. Abstr., 42: No. 3, March 1962)

19191 ABOUT FALLOUT, BOMBS, SHELTER, MINED CITIES AND DOOMSDAY MACHINES. Atomics, 15: No. 2, 12-20(Apr.-June 1962).

An account is given of the consequences of nuclear war. The question of survival is discussed with respect to the effect of the nuclear explosion and the use of fall-out shelters. A nuclear explosion is discussed with respect to type of explosion (air, surface, or underground), blast effects, thermal effects, initial radiation, local fall-out, world-wide fall-out, and water wave generation from underwater, surface, and air bursts. The effects of a surprise attack, the point of explosion, the cost and types of bombs feasible for various conditions, and the possibility of nuclear war are discussed. (N.W.R.)

19192 A RAPID METHOD FOR ESTIMATING THE RADIATION HAZARD ON THE BASIS OF THE PRESENCE OF RADON DECAY PRODUCTS IN THE AIR. K. P. Markov, N. V. Ryabov, and K. N. Stas'. Atomnaya Energ., 12: 315-19(Apr. 1962). (In Russian)

The daughter products of Rn contribute considerably to the absorption dose in the lung tissue and their concentration must therefore be determined simultaneously with that of Rn itself. The concept of "latent energy" expressed by H. Kusnetz (Amer. Ind. Hygiene Assn. Quarterly Greek, 17: 85(1956)) which refers to the energy liberated by the total α decay down to Ra D of all the short-lived daughter products is a suitable index of the aerial contamination. The value of 1.3×10^4 Mev/liter corresponds to the maximum permissible concentration of 1×10^{-11} curies/liter. Of all the daughters, Ra A is considered to be the most important contributor to the internal dose and was therefore chosen to be determined together with the latent energy. Equations were derived for determining these values with a sufficient accuracy at various equilibrium levels from deposits formed on filter paper after passage of the desired amount of air. This method is considered to be a useful indicator of radiation safety because it permits results to be obtained within 15 minutes and gives a clear picture to which individuals might be exposed. (TTT)

19193 DETERMINATION OF THE CONCENTRATION OF AEROSOLS OF SHORT-LIVED DECAY PRODUCTS OF RADON. N. P. Kartashov and G. A. Popov. Atomnaya Energ., 12: 336-8(Apr. 1962). (In Russian)

The filtration method used for determining the aerosol concentration is quite sensitive but it requires a complex apparatus which makes its use in the field too difficult. A simpler method was developed especially for measuring the concentration of aerosols containing short-lived decay products of Rn. The method is based on the increase of the α count rate in a chamber containing the air sample being tested. By determining the count rate at three specific points of the curve, e.g., at $t_1 = 2$ min, $t_2 = 15$ min, and $t_3 = 60$ min, and solving the set of 3 equations, the numerical values of the efficiency coefficients corresponding to Rn, Ra A, and Ra C' may be obtained. Any shift in the radioactive equilibrium may be calculated from the set of curves. At relatively high Rn decay product concentrations (above 100 micromicrocuries/liter) and at steady operation of the apparatus at which the mean-squares error does not exceed the expected statistical spread, the coefficients of the shift of the radioactive equilibrium may be determined. A "scintillation emanometer" consisting of the control equipment and two scintillation chambers was used to verify the theoretical predictions experimentally. The apparatus was calibrated with standard radiation sources and was tested in the field. The results indicated that in the mining ventilating system studied there is a complete equilibrium between Rn and its short-lived decay products. (TTT)

19194 ESTIMATION OF RADIOACTIVE CONTAMINATION OF THE FOOD CHAIN. A. Chevallier and R. Schneider. Bull. inst. natl. hyg., 16: 207-72(1961).

Results are given of a study made from 1958 to 1960 on Sr^{89}, Sr^{90}, and β radioactivity of K^{40} and alkaline earth metals in milk, cheese, grass, alfalfa, and other vegetable materials; Sr^{89}, Sr^{90}, and β radioactivity of alkaline earth metals in bone; Cs^{137} and I^{131} in milk; and Sr^{89} and Sr^{90} in wine. After nuclear explosions in 1958 and 1959, radioactivity in forage and then in milk increased and later fell to values far below the maximum allowed. Values for milk and grass in the Vosges were often 10 to 20 times those in the Alsace plain. Milk from the Vosges had up to 50 $\mu\mu$C per g Ca in July 1959. (Public Health Eng. Abstr., 42: No. 3, March 1962)

19195 CLOTHING PROBLEMS POSED BY THE OPERATION OF RADIOACTIVE INSTALLATIONS AND THEIR SOLUTIONS. J. Rodier, H. Bouzigues, and P. Boutot (Commissariat à l'Énergie Atomique, Marcoule, France). Energie nucléaire, 4: 43-56(Jan.-Feb. 1962). (In French)

The various methods used for preventing the contamination of the work clothes of persons in radioactive installations are discussed. The problems connected with the clothing and its decontamination and laundering in large nuclear energy plants are considered in some detail. The German countercurrent method (Sulzman system) permits the rapid washing of clothes and produces very little liquid wastes. Dry cleaning is a possible future economic tech-

nique. The Marcoule laundry installation is described as an example. (tr-auth)

19196 RADIATION MEASUREMENTS OVER SIMULATED PLANE SOURCES. F. J. Davis and P. W. Reinhardt (Oak Ridge National Lab., Tenn.). Health Phys., 8: No. 3, 233-43(June 1962).

To better interpret aircraft measurements of fallout, a simulated plane source array was laid out with positions at 100-ft intervals in the form of a square each side of which measured 2000 ft. For ground measurements a smaller square array of 100 positions at 10-ft intervals was placed in the center of the large array. Two sets of sources were used in the array. Co^{60} and Cs^{137} sources of 4.5 and 15 mc, respectively, were available to be placed in the large array and sources one-hundredth of these values in the smaller array. Measurements 3 ft above ground indicated 200 μr/hr for Co^{60} and 225 μr/hr for Cs^{137}. Measurements were made in aircraft at 100-ft intervals above the array using scintillation counters and a 256-channel scintillation spectrometer. Flights for comparison of point sources were made over Co^{60}, Cs^{137}, and I^{131}. Relationships of the radiation intensity above point and plane sources as well as spectral data are given. For these sources the tests demonstrate that above certain heights the effect of build-up cannot be neglected but is adequately represented by a linear formula. (auth)

19197 AN EVALUATION OF THE HEALTH PHYSICS PROBLEMS FROM THORIUM AND ITS DAUGHTERS IN A THORIUM PURIFICATION AND FABRICATION PROCESS. C. M. West (Union Carbide Nuclear Co., Y-12 Plant, Oak Ridge, Tenn.). Health Phys., 8: No. 3, 279-97(June 1962).

Evaluation of the health physics problems associated with thorium processing is complicated by the presence of the short-lived daughters of the decay chain. Measurements made during exploratory thorium purification and fabrication processes included direct counting, α- and γ-spectrometry, and in vivo counting. Data, illustrating and defining the daughter complications, are reported. These data indicate that, in many cases, over 90% of the α-activity noted by conventional counting techniques is due to the daughter elements. It is concluded that a realistic evaluation of radiological hazards associated with thorium processing should include isotope identification techniques as well as screening by direct radiological counting. (auth)

19198 DETERMINATION OF THE RADIATION PROTECTION FACTOR REQUIRED FOR A FALLOUT SHELTER. E. Schonfeld. Health Phys., 8: No. 3, 313(June 1962).

The total integrated radiation dose, 1 to 4 weeks after a nuclear attack, will be approximately $I \simeq 3D_t t$, where I is the integrated dose in roentgen, t is the time after the attack in hours and D_t is the dose rate in roentgens per hour at the time t. This approximate equation is valid only for values of t ranging from about 0.3 to 12 hr. If the dose rate after 1 hr is 1000 r/hr, then the integrated dose after 1 to 4 weeks will be about 3000 r. It is interesting to note that the integrated dose after 1 to 2 days will be about two-thirds of this value, or around 2000 r. Data are included on the probability of survival at various levels of exposure. The shielding protection factor, PF, required will be $PF = (I/LD) \simeq (3D_t t/LD)$. Thus, the PF depends on the initial dose rate and the LD selected. This same equation can be used to predict the chances of survival after a nuclear attack if the PF is known and a radiation detector is available. Examples are included. (C.H.)

19199 SAFETY AND HEALTH. I. SAFER THAN SAFE? A. S. McLean (United Kingdom Atomic Energy Authority, [Harwell, Berks, Eng.]). J. Brit. Nuclear Energy Soc., 1: 93-7(Apr. 1962).

The standards now followed in radiological protection are based upon exceedingly pessimistic predictions of the possible effects of exposure at very low rates to small doses of ionizing radiation. There are no grounds for collective or individual concern about the immediate or long-term effects of exposure within the present permissible limits. No further reduction in these limits should therefore be contemplated in the absence of adequate biological justification. The effects of radiation in inducing leukemia is analyzed in order to prove the effectiveness of the current recommendations of safety limits. (N.W.R.)

19200 SAFETY AND HEALTH. 2. THE BASIS FOR MEDICAL SUPERVISION OF PEOPLE EXPOSED TO IONISING RADIATION. J. A. Bonnell. J. Brit. Nuclear Energy Soc., 1: 98-102(Apr. 1962).

The aims and limitations of the medical supervision of industrial workers exposed to ionizing radiation are discussed after the general philosophy, and the broad points of knowledge of radiation effects on the body are outlined. The factors which influence the selection of workers are also discussed. These factors are age, medical history, occupational history, physical condition, blood condition, and sex. The methods used in biological monitoring are also discussed. (N.W.R.)

19201 THE CONTAMINATION OF MILK WITH Sr^{90}. H. Seidler and M. Haertig (Institut für Ernahrung der Deutschen Akademie der Wissenschaften, Berlin). Kernenergie, 5: 42-6(Jan. 1962). (In German)

The Sr^{90} activity of milk collected during 1960 from three different sites of the DDR is reported. The results show that milk from the south contained a third more Sr^{90} than that from the north or middle section of the DDR and that a significant decrease of the contamination was detectable in the spring. It could also be shown that the Sr^{90} activity of the milk parallels the ground burden from fall-out and precipitation. An attempt was made to find an explanation for the periodically occurring yearly maxima of milk contamination by constructing curves relating fall-out, harvest, and feeding. The averages of the years 1955 to 1960 were compared and the discrimination factors soil-grass-milk found in deer pons are given. An investigation of Sr^{90} reduction in milk through supplementary calcium feedings is described. In the study the activity was reduced 20 to 25%. (tr-auth)

19202 CONTAMINATION OF MILK WITH RADIOACTIVE Sr^{90} IN COMPARISON WITH OTHER FOODS. E. Knoop. Milchwissenschaft, 16: 169-76(1961).

The problem of radiation to which the human body is exposed is discussed in general terms. In Germany cereal grains contain the highest proportion of Sr^{90} per g Ca, but only a small proportion of the total remains in flour. Fruit and vegetables also contain a relatively large amount of Sr^{90} in relation to Ca. Nevertheless, the most important source of Sr^{90} for man is milk, although its Sr^{90} : Ca ratio is lower; cereals come next in importance. Contamination of all foods in Germany has as yet been far below the permitted maximum and has fallen since 1959. (Public Health Eng. Abstr., 42: No. 3, March 1962)

19203 SAFE LIMITS OF OCCUPATIONAL AND GENERAL EXPOSURE TO RADIATION. John F. Loutit (Medical Research Council, Harwell, Berks, Eng.). Roy. Soc. Health J., 81: 233-6(Sept.-Oct. 1961).

The biological effects of radiation are reviewed from the standpoint of safe limits of occupational and general exposure to radiation. It is pointed out that many people are exposed to small doses of radiation through their occupations. Those occupationally exposed are all over age 18

and under the supervision of competent medical authorities. The principal limiting factor as far as exposure of the general population is concerned is the genetic problem of inheritance, and this must be considered carefully in establishing limits for radiation exposure. (C.H.)

19204 STRONTIUM-90 IN MAN. [PART] V. J. Laurence Kulp and Arthur R. Schulert (Lamont Geological Observatory, Palisades, N. Y.). Science, 136: 619-32(May 18, 1962).

It is now possible to predict the strontium-90 concentration in the world population for specified modes of atmospheric contamination with moderate reliability. For example, the average adult bone level in the eastern United States 5 years after the detonation of a specified quantity of fission products into the lower polar stratosphere can probably be estimated to better than ± 50 percent. The concentration of strontium-90 in fetuses reached a maximum of 1.2 micromicrocuries of strontium-90 per gram of calcium in eastern North America and began to decrease significantly in 1960 and 1961. The ratio of the strontium-90 level in the fetus to the level in the average diet of the adult is about 0.08. The average rate of turnover of strontium and calcium in the adult skeleton appears to be about 2.5 percent per year, although there is considerable difference among the various bones of the body. The standard deviation for strontium-90 concentration in a population of urban adults appears to be about 40 percent of the mean. The distribution curve for an interval of from 60 to 0.1 percent of the population may be approximated by the log-normal function. In urban populations of Western culture the concentration for 5 percent of the population will exceed twice the mean, that for 0.1 percent will exceed four times the mean. Cities in the Southern Hemisphere showed levels in bone about half those for cities of Western culture in the Northern Hemisphere in 1960, yet the fallout in the Southern Hemisphere is only one-fourth that in the Northern Hemisphere. This is attributed to differences in diet, with a higher milk component in the Northern Hemisphere. A simple model for the strontium-90 concentration in the bones of young people as a function of their age appears to fit the experimental data. The coefficients of the equation describing the relative contributions of the rate of fallout (direct absorption) and the cumulative deposit (soil uptake) to the strontium-90 concentration in milk have been calculated from the observed data for 1959 and 1960. They are as follows: rate factor A = 0.65 micromicrocurie of strontium-90 per gram of calcium in milk per millicurie of strontium-90 per square mile during the growing season; cumulative-deposit factor B = 0.12 micromicrocurie of strontium-90 per gram of calcium in milk per millicurie of strontium-90 per square mile at the midpoint of the growing season. The predicted levels in milk for 1958 obtained with these coefficients are in excellent agreement with the observed levels. In 1958 and 1959 about half the strontium-90 in milk was attributable to the rate factor, whereas in 1960 the contribution of the rate factor dropped to about 15 percent. Future levels of strontium-90 in man are given for the next decade as a result of the nuclear tests through 1961 and under the assumption that 1.0 megacurie of strontium-90 is added to the stratosphere of the Northern Hemisphere each year. The radiation doses to the skeleton to be expected from world-wide fallout on the basis of a 3000-megaton (fission yield) war are also given. (41 references.) (auth)

19205 TRITIUM MEASUREMENTS IN RAIN WATER WITHOUT ISOTOPIC ENRICHMENT. H. v[on] Buttlar, W. Stahl, and B. Wiik (Technische Hochschule, Darmstadt, Ger.). Z. Naturforsch., 17a: 91-2(Jan. 1962). (In German)

A large counter tube which exhibits a low zero effect and a high recording probability for tritium β radiation was constructed. With it, it is possible to measure the tritium concentration in rain water without isotopic enrichment with a counting time of 10 hr and a simple statistical error of about 10%. The parameters of this counting tube are given. The results of measurements made between August and November 1961 are reported. The probable origin of the tritium detected is discussed. (J.S.R.)

19206 NUCLEAR SAFETY. Technical Progress Review, Vol. 3, No. 2. W. B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). Dec. 1961. 89p. $0.55(GPO) (Domestic), $0.70(GPO)(Foreign).

Reviews of selected subjects in the field of nuclear safety are presented. Included are sections concerned with general safety criteria, accident analysis, control and instrumentation, plant safety features, consequences of activity release, and reviews of current activities. (J.R.D.)

19207 THE EFFECTS OF POLLUTION ON LIVING MATERIAL. Symposia of the Institute of Biology, No. 8. W. B. Yapp, ed. London, The Institute of Biology, 1959. 164p.

Separate abstracts were prepared on 4 papers from the symposium covering various phases of radioactive contamination. Other papers presented summarized recent information on the effect of various kinds of pollution in rivers and estuaries and on land. Emphasis is placed on the waters of Great Britain. (C.H.)

19208 DISPOSAL OF RADIOACTIVE WASTES. R. H. Burns (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.103-12 of "The Effects of Pollution on Living Material." London, The Institute of Biology, 1959.

Problems associated with the disposal of radioactive wastes arising from the processing of spent nuclear fuel from reactors, effluents from the atomic energy research centers, and uranium processing plants, and hospitals using radioactive materials are reviewed. Storage, dispersal, and various treatment methods are discussed. Regulations governing the disposal of radioactive wastes in Great Britain are outlined. (C.H.)

19209 THE UPTAKE OF FISSION PRODUCTS BY PLANTS. H. J. M. Bowen (Wantage Radiation Lab., Grove, Berks, Eng.). p.113-23 of "The Effects of Pollution on Living Material." London, The Institute of Biology, 1959.

Processes involved in the formation of fission products in atomic reactors and by atomic explosions are reviewed. Hazards due to the uptake of fission products by plants are discussed. (C.H.)

19210 FISSION PRODUCTS AND AQUATIC ORGANISMS. W. L. Templeton (United Kingdom Atomic Energy Authority, Sellafield, Cumb., Eng.). p.125-40 of "The Effects of Pollution on Living Material." London, The Institute of Biology, 1959.

The potential health hazards associated with the marine disposal of radioactive wastes are discussed. Results are summarized from a number of studies on the uptake and accumulation of fission products by aquatic organisms. It is concluded that an indirect hazard may arise through the accumulation of radioactive isotopes from the diluting medium by organisms used as human food. Wide differences in species concentration of various nuclides have been found. It is pointed out that radioisotopes of Sr and Cs are probably always in the ionic form in sea water, while Ru^{106} forms colloids and adsorbs on to particles. Data are tabulated on the estimated accumulation factors

for various radionuclides in various aquatic organisms. (C.H.)

19211 GENETIC EFFECTS OF RADIOACTIVE POLLUTION. T. C. Carter (Medical Research Council, Harwell, Berks, Eng.). p.141-50 of "The Effects of Pollution on Living Material." London, The Institute of Biology, 1959.

Fall-out from reactor accidents and nuclear explosions constitutes an external source of radiation and a potential source of internal irradiation through the ingestion of contaminated water or food. Once ingested, the radioactive material may be incorporated into the body, thereby constituting an internal source of radiation. The biological effects of the radiation may be manifest as somatic effects or genetic effects which are manifest in later generations. Data are reviewed from studies on the genetic effects of low-level radiation. The need is stressed for new experimental data on the nature of dose/mutation relationship in the low dose range. (C.H.)

19212 NUCLEAR RISK IN OCEAN TRANSPORT AND ITS INSURABILITY. Papers Read at The Forum on Ocean Transport of Radioactive Materials, January 23, 1962. New York, International Insurance Monitor, 1962. 71p.

Seven papers are included on various aspects of nuclear energy; handling and transport of radioactive materials; special hazards and degree of risk involved in such transport; appropriate safety measures and programs of various federal agencies involved in these matters; and property, liability, cargo, and other kinds of insurance necessary and available to shippers, processors, and other handlers of the materials. (N.W.R.)

19213 CIVIL DEFENSE TRAINING EQUIPMENT. George Vernon Hough, Richard Harry Rhead Cronin, and Raymond John Cox (to Plessey Co. Ltd.). U. S. Patent 3,035,772. May 22, 1962.

A method is given for simulating nuclear weapon fall-out for training of Civil Defense personnel. The method comprises laying one or more cables on or below the ground and passing a-c electric current through the cables to create a magnetic field. Magnetic field patterns of almost any shape or size may be established with the appropriate cable layout, and the field may be made to decrease with time. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstract 19275.

19214 (ARF-1194-10) LITERATURE SURVEY ON WORLD ISOTOPE AND RADIATION TECHNOLOGY. Quarterly Report, December 15, 1961 to March 14, 1962. J. W. Haffner and D. Oestreich (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 11, 1962. Contract AT(11-1)-578. 14p.

In this period, the detailed evaluation of various fields of radioisotope research was extended. Preliminary results on the use of radioisotopes in the industrial applications, apparatus and techniques, and metallurgy categories are presented. These preliminary studies indicate the quantity of research, growth rates, and specialized areas of interest in various countries of the world. More detailed evaluations of these categories will be presented in the final report. (auth)

19215 (NCSC-2477-5) APPLICATIONS OF RADIOISOTOPES AND ACTIVATION ANALYSIS TO TEXTILE MATERIALS AND PROCESSES. Final Report, November 1, 1958–November 30, 1961. Arthur A. Armstrong, Jr. and Henry A. Rutherford (North Carolina State Coll., Raleigh. School of Textiles). Jan. 1, 1962. Contract AT(40-1)-2477. 99p.

Gamma spectra are presented for most of the commerical textile fibers and a list of the isotopes identified in each fiber is given. It was demonstrated that copper, manganese, and gold could be added to cotton yarns as tracers for activation analysis. Size and finish solutions were also tagged with gold and activation analysis used to determine size and finish pick-up on cotton yarn and fabric. The use of a beta-gage for measu-ing cloth weight continuously was demonstrated. (auth)

19216 (TID-4563(3rd Rev.)) SPECIAL SOURCES OF INFORMATION ON ISOTOPES. (Division of Isotopes Development, AEC). 1961. 99p.

A bibliography on isotopes is presented. An introductory description of isotopes and their uses is included. The 648 references are arranged by subject. A title, author, and report number index is given. The availability of references is discussed. (M.C.G.)

19217 (AEC-tr-5034) APPLICATIONS OF RADIOISOTOPES IN ANIMAL HUSBANDRY AND VETERINARY SCIENCE. (Primenenie Radioizotopov v Zhivotnovodstve i Veterinarii). A. A. Kudryavtsev and A. I. Vertunov. Translated from a paper presented at the Conference on the Use of Radioisotopes in Animal Biology and in the Medical Sciences held in Mexico City, November 21 to December 1, 1961. 20p.

Work by Soviet researchers on the use of radioisotopes in animal husbandry and veterinary science is reviewed. (M.C.G.)

19218 (CEA-tr-R-1424) EFFET DE L'IRRADIATION γ SUR LA QUALITE DE LA FARINE DE BLE, SUR L'ELASTICITE ET LA TENACITE DES PROTEINES DU GLUTEN ET DE LA PATE, AINSI QUE SUR LA QUALITE DU PAIN. (Effects of γ Irradiation on the Quality of Wheat Flour, on the Elasticity and Tenacity of the Gluten in the Dough, as well as the Quality of the Bread). B. A. Nikolaev (Nikolaiev) and S. S. Chkadina. Translated into French from Khlebopekar i Konditer. Prom., 4: No. 5, 8-10(1960). 9p.

The effects of γ radiation on the quality of wheat flour and on the elasticity and tenacity of dough and gluten were studied. The irradiated flour was affected with a disagreeable order of oxidized grease. Irradiation with 1 to 2,000,000 r of flour of normal quality and of dry gluten extracted from this flour causes a sharp elevation of tenacity of the dough and of the hydrated gluten, whereas the modulus of elasticity for the deformation for these structures remains unchanged. The volume of bread produced from irradiated flour of normal quality was superior to that obtained with nonirradiated flour. This is explained by the elevation of the tenacity modulus of the dough. Crumbs of bread made with irradiated flour have a deeper color than bread from nonirradiated flour. Results of irradiation of flour of inferior quality show not only an increase of the tenacity of the dough, but also an increase of the elasticity modulus. The tenacity modulus ratio of the dough does not vary except in the case of a dose of 1,000,000 r. (tr-auth)

19219 THE POSSIBLE USES OF HIGH-ENERGY RADIATION AND THEIR SIGNIFICANCE FOR INDUSTRY. Ernst-Guenter Hofmann (Allgemeine Elektricitäts-Gesellschaft, Berlin). Atomkernenergie, 7: 139-47(Apr. 1962). (In German)

An investigation was made of the possibilities of the application of high-energy radiation in the various branches of science and industry. The use of radiation has special significance in certain sections of chemistry, food industry, pest control, and pharmaceutics. A discussion is presented on the industrial applications already known at the present time, and on future prospects. The introduction of further processes depends to a certain extent on the reduction of irradiation costs and the manufacture of powerful radiation sources. For practical applications, isotope sources, high-power x-ray apparatus, and electron accelerators can be used rationally, depending on the purpose of application. The advantages of the x-ray equipment are described. (auth)

19220 AUTOMATIC CONTROL APPARATUS BASED ON RADIO ELEMENTS FOR THE CHEMICAL INDUSTRY. S. Margolinas. Énergie nucléaire, 4: 40-2(Jan.-Feb. 1962). (In French)

After a brief review of the principles of measurements with radioactive sources, instruments produced in France using radioisotopes, and which are utilized in the petroleum petrochemical, and chemical industries, are described. (tr-auth)

19221 EFFECTS OF FEEDING X-IRRADIATED PORK TO RATS, ON THEIR THIAMINE NUTRITION AS REFLECTED IN THE ACTIVITY OF ERYTHROCYTE TRANSKETOLASE. Myron Brin, A. S. Ostashever, Mary Tai, and Helen Kalinsky (Food and Drug Research Labs., Inc., Maspeth, N. Y.). J. Nutrition, 75: 29-34(Sept. 1961).

Chemical analysis showed that thiamine was destroyed to the extent of 92 and 98% in pork exposed to ionizing radiations at levels of 2.79 and 5.58 megarad, respectively. Unirradiated pork, when incorporated into diets at 35% on a dry weight basis contained sufficient thiamine to support normal growth and normal erythrocyte transketolase ac-

tivity in rats. X-irradiated pork, unsupplemented with thiamine, resulted in growth retardation of rats to the extent of 53 and 63% and a depression of erythrocyte transketolase to the extent of 83 and 94% (on a hexose basis) when fed to rats at 35% of the diet on a dry weight basis for a 4-week feeding period. Treatment of the rats fed the diet containing irradiated pork with thiamine hydrochloride resulted in a rapid resumption of the normal growth rate and a concomitant increase in erythrocyte transketolase activity. (auth)

19222 EFFECTS OF FEEDING X-IRRADIATED PORK TO RATS ON THEIR PYRIDOXINE NUTRITION AS REFLECTED IN THE ACTIVITY OF PLASMA TRANSAMINASES. Myron Brin, A. S. Ostashever, Mary Tai, and Helen Kalinsky (Food and Drug Research Labs., Inc., Maspeth, N. Y.). J. Nutrition, 75: 35-8(Sept. 1961).

Pork samples which were x-irradiated at the 1 × (2.79 megarad) and at the 2 × (5.58 megarad) levels and unirradiated pork were incorporated into diets at 35% on a dry-weight basis and fed to rats in the following 4 groups: control pork with added pyridoxine (DPO), control pork without added pyridoxine (DPO-P), 1 × pork without added pyridoxine (DP3-P), and 2 × pork without added pyridoxine (DP-6). Growth was followed for 12 weeks at which time plasmas were submitted for the determination of the alanine and the aspartic transaminase enzymes. No differences in growth were noted. Although no effect was seen on the activity of the aspartic transaminase, the plasma alanine enzyme was depressed significantly and increasingly in the DPO-P, DP3-P, and DP6-P groups, respectively. It was concluded that the rats fed the x-irradiated pork were subject to marginal deficiency of pyriodoxine. (auth)

19223 RADIOACTIVE ISOTOPES IN ALUMINUM METALLURGY. D. De Voedroes. Met. constructia masini, No. 11, 1037-8(1960).

A new method for the determination of molten aluminum in the electrolytic furnace by radioactive isotopes is reviewed. The determination is accomplished as follows: a certain amount of artificial radioactive isotope is added to the molten aluminum in the electrolytic furnace; after uniform mixing, a sample of molten aluminum is taken out; the quantity of the molten aluminum is determined on the basis of the specific activity reduction of the sample by using the relation: $m = m_0 (S_0/S)$, in which m_0 is the weight of the sample introduced into the electrolytic furnace, S_0 – the specific activity of the sample before being introduced into the electrolytic furnace, and S – the specific activity of the sample after dilution. Investigations were done in five steps: checking of the uniform distribution of the radioactive isotope in the metal bath; selection of the radioactive isotope and determination of the isotope quantity introduced in the molten aluminum: during the first investigations Fe^{59} with a half life of 46 days was used, whereas in later experiments Au^{198} with a half life of 2.65 days was used; introduction of radioactive isotope into the prealloy; measuring of the specific activity of the samples and calculation of the quantity of the molten aluminum; and performance of some checking tests by weighing the content of some crucibles. The quantity of the molten aluminum was established with an accuracy of 1%. (OTS)

19224 NUCLEAR BATTERIES. Kliment Söler. Pokroky mat., fys. a astron., No. 1, 15-23(1961).

General descriptions of the development and principle design of various types of nuclear batteries are given. Nuclear batteries are classified into the following types: directly-charged, which consist of a primary source of energy (α or β emitter) and a suitable collector electrode; semiconductor (p-n) junction, which deliver larger amperages but lower voltages; contact-potential, which employ an isotope to ionize a gas in an electric field obtained by the contact-potential difference of two electrodes; and thermoelectric nuclear batteries, which employ thermocouples and absorb heat produced as radioactivity. It is concluded that batteries reach considerably higher efficiencies when excited by sunlight instead of nuclear radiation (solar batteries). (P.C.H.)

19225 PROSPECTS FOR THE USE OF RADIOACTIVE ISOTOPES AND NUCLEAR RADIATIONS IN THE GLASS INDUSTRY. S. M. Brekhoviskikh. Steklo i Keram., No. 9, 20-3(1961).

Applications of isotopes and nuclear radiations in industry, agriculture, building, and in various fields of scientific research are described. At present more than 200 radiation sources of 14 radioactive isotopes are being produced. Methods employing isotopes are given for the preparation of sand for glass works in flotation plants. The humidity of concrete, gravel, and sand can be determined by recording the absorption intensity of gamma radiation, the error being <2% of humidity. A radiometric device used for measuring the thickness of coatings on glass is described. A more detailed knowledge of glass structure was gained by the study of electron paramagnetic resonance and nuclear quadrupole and nuclear magnetic resonance of glasses irradiated by gamma and x rays. Thermoluminescence spectra may be used for detecting microheterogeneities in irradiated glasses. (P.C.H.)

19226 EFFEKTIVNOST' RADIOAKTIVNOGO KONTROLYA V MASHINOSTROENII. PRIMENITEL'NO K GAMMA-DEFEKTOSKOPII. (Effectiveness of Radioactive Inspection in Machine Building. Application of Gamma Defectoscopy). V. I. Postnikov and V. A. Letenko. Moscow, Mashgiz, 1960. 148p.

Applications of radioactive isotopes in the machine building industry are investigated and calculation methods and practices are discussed. The problems of organization, techniques, and rational limits of radioisotopic testing in industry are analyzed, and safety rules for handling radioisotopes are suggested. (R.V.J.)

ISOTOPE SEPARATION

19227 ANALYZING GAS CENTRIFUGE FOR FUEL FABRICATION. Paul Hamel (A. V. Roe Canada Ltd., Toronto). Can. Nuclear Technol., No. 4, 48-53(1962).

The theory underlying the application of the gas centrifuge for the industrial scale production of uranium fuel with low enrichment is reviewed. The isotope separation process shows that a rational choice of plant parameters should be made from an over-all optimization study including local economic effects. The theory also suggests that the sectional type cascade arrangement be used. The analytical equations are kept simple for this theory. (N.W.R.)

19228 AN ELECTROLYTIC DEVICE FOR PREPARING PURE $H_2(D_2)$ GAS. János Nagy and Péter Gombos. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 4: 231-3(1961). (In Hungarian)

It is highly desirable to feed very pure gases to the ion sources of accelerators because subsequent purification steps cause a change in the partial pressure of an impure gas. For this reason a novel electrolytic apparatus was developed; it yielded high-purity $H_2(D_2)$ gas under a pressure of 1 atm which could be fed directly into the ion source without recourse to the usual purification step. The electrolyzer used an electrolyte of 10% NaOH and was provided with Ni anodes and Hg seals. The $H_2(D_2)$ generated between the electrolyte and the seal was evacuated by means of a water-air jet. The purity of the mixture was determined by means of a radiofrequency ion source and a magnetic mass spectrometer; it contained only 2% of impurities consisting mostly of heavy ions which were bound on the walls of the ion source or leaked in. (TTT)

19229 LOW-TEMPERATURE DISTILLATION OF HYDROGEN ISOTOPES. Natl. Bur. Standards (U.S.), Tech. News Bull., 43: 116-18(June 1959).

A pilot plant for separating hydrogen isotopes by a cryogenic distillation process is described. The plant distills the liquid hydrogen by fractionation. The separation yields specific amounts of pure liquid deuterium and deuterium-free hydrogen. The process and equipment is particularly well suited for industrial areas where extensive supplies of hydrogen are available (near ammonia plants). The flow system is schematically shown. (N.W.R.)

19230 ON THE INDUSTRIALIZATION OF THE ELECTROLYTIC CONCENTRATION METHOD OF HIGHLY ENRICHED HEAVY WATER. II. RECOMBINATION AND REMOVAL OF ALKALI. Masami Shimizu, Saburō Nitō, and Akishige Harada. Nippon Genshiryoku Gakkaishi, 4: 211-17(Apr. 1962). (In Japanese)

The Showa Denko electrolytic cell is safer for separating oxygen and hydrogen than the cell in which detonating gas is treated. In the burning process, hydrogen is directly combusted in the oxygen stream. This process increases the heavy water yield to approximately 100% and allows recombination to occur safely. With respect to dialkalization, combination of the ion exchange membrane process and mercury cathode process simultaneously dealkalizes the enriched electrolyte and caustifies make-up water, thus eliminating the existing process which comprises carbonation and distillation. (N.W.R.)

19231 INCREASE OF NOZZLE'S SEPARATION OF ISOTOPES BY ADDITION OF LIGHT GASES. E. W. Becker, K. Bier, and W. Bier (Kernforschungszentrum and Technische Hochschule, Karlsruhe, Ger.). Z. Naturforsch., 16a: 1393(Dec. 1961). (In German)

Since the addition of a light gas to the isotopic mixtures to be separated by the separation nozzle process increases the mass difference of the isotopes, it is to be expected that the separation of heavy isotopes could be increased by the addition of gases with low molecular weight. This effect was studied on a mixture of argon and helium, and the separation of Ar^{36} and Ar^{40} was determined by mass spectroscopy. The maximum separation of argon isotopes in the mixture was greater by a factor of 1.7 than in the pure argon. (J.S.R.)

19232 GAS CENTRIFUGE FOR THE CONCENTRATION OF ISOTOPES. (to Licentia Patent-Verwaltungs-G.m.b.H.). British Patent 896,126. May 9, 1962.

A gas centrifuge is designed which causes a gas to rotate in a stationary drum by means of a magnetic field and a gas discharge within the gas space of the drum. In this way, peripheral speeds many times that of the known gas centrifuges with a rotating drum can be obtained. Various designs of the centrifuge for improved isotope separation are discussed. (D.L.C.)

19233 IMPROVEMENTS IN OR RELATING TO DEUTERIUM CONCENTRATION PROCESSES. Albert Raymond Kenyon and Arthur John Birch (to United Kingdom Atomic Energy Authority). British Patent 896,269. May 16, 1962.

A method is given for increasing the rate of deuterium exchange between H_2 gas and NH_3 liquid, with potassamide as catalyst. The method comprises adding to the NH_3 liquid a primary or secondary aliphatic amine, particularly a saturated cyclic secondary amine, such as pyrrolidine. Two examples of the method are given in which the exchange rate was increased by a factor of 5 to 3. (D.L.C.)

MATHEMATICS AND COMPUTERS

19234 (ANL-6521) A GENERAL 704 SERVICE LIBRARY. P. S. Bagus and C. C. J. Roothaan (Argonne National Lab., Ill. and Chicago. Univ. Lab. of Molecular Structure and Spectra); W. S. Worley, Jr., and M. C. Wunderlich (Chicago. Univ. Lab. of Molecular Structure and Spectra). Mar. 1962. Contract W-31-109-eng-38. 70p.

A unified set of input, output, and diagnostic routines for the Argonne IBM 704 digital computer is described. The library is designed to give maximum ease in programming the input and output functions required by a program. It also provides for rapid execution of diagnostic and emergency dumps. (M.C.G.)

19235 (DC-60-7-12) OFF-DESIGN AND MODIFIED OFF DESIGN PROGRAMS (PROGRAMS 99 AND 443). J. A. Delaney, P. A. Dyer, and S. C. Skirvin (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 1960. Contract AT(11-1)-171. 75p.

The initial and current versions of the "OFF-DESIGN" program, ANP 704 programs No. 99 and 443 are given. Program No. 443 is an extensive revision of Program No. 99, although it performs basically the same calculations. The program computes, for a given set of inlet conditions, the stage by stage total pressure losses, total air temperatures, and trailing edge surface temperatures, and various pressure drops and pressure ratios for a flow passage with heat addition, friction losses, and entrance and exit losses. (auth)

19236 (HW-73381) MAC–A BULK SHIELDING CODE. E. G. Peterson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1962. Contract AT(45-1)-1350. 87p.

The MAC Computer Code provides a method for calculating neutron and gamma attenuation through reactor shield assemblies. The code was tested by comparing calculations with experimental data on material obtained in the Hanford Bulk Shield Facility. The materials include iron-masonite, ferrophosphorus concrete, iron-serpentine concrete, and ordinary concrete. The cases involved total material thickness of 210 to 230 cm, and attenuation factors of about 10^{12} and 10^{11} for neutrons and gammas, respectively. The calculations provided an excellent fit to the experimental data and generally agreed with measured flux values. The agreement was considered to be very satisfactory in view of the large thickness and attenuation factors involved. An over-all reduction in the amount of experimentation required to find an optimum shield material is achievable with the MAC code. Calculation of the shielding properties for new materials may be carried out in bulk shielding facilities and only the most promising tested. Agreement between calculation and experimental results obtained from the bulk shielding facilities geometry then permits calculation for other geometries with a high degree of confidence. (auth)

19237 (KAPL-M-FDF-1) RAUM–SOLUTION OF ONE DIMENSIONAL COUPLED DIFFUSION-TYPE EQUATIONS ON THE PHILCO-2000. Francis D. Federighi (Knolls Atomic Power Lab., Schenectady, N. Y.). Feb. 19, 1962. Contract W-31-109-Eng-52. 38p.

A program (RAUM) for solving any set of up to eight coupled diffusion-type equations is described. Arbitrary coupling in both the diffusion and absorption terms is permitted. Either source problems or eigenvalue problems with source iteration can be solved. The method of solution is that of simultaneous group inversion. The eight equations are considered as one matrix equation which is solved in a manner analogous to usual one-equation methods. (auth)

19238 (ORNL-TM-221) A TRANSLATOR-ORIENTED INTERMEDIATE COMPUTER LANGUAGE. A. A. Grau (Oak Ridge National Lab., Tenn.). May 4, 1962. Contract [W-7405-Eng-26]. 5p.

An intermediate language is described that was developed for the translation process for Algal programs and its requirements in terms of target language. The requirements made of the target language were that it be parenthesis-free, that it contain a minimum number of instruction types, and that it would simplify the translation process. The feasibility of this language as target language to simplify the machine translation process and the direct implementation of this language on a computer by means of suitable hardware is considered. (C.H.)

19239 (ORNL-TM-234) A SYSTEM FOR GENERATING GAMMA RAY CROSS SECTION DATA FOR USE WITH THE IBM-7090 COMPUTER. S. K. Penny, M. B. Emmett, and D. K. Trubey (Oak Ridge National Lab., Tenn.). May 16, 1962. Contract [W-7405-Eng-26]. 6p.

A system for generating detailed tables of gamma ray cross section data has been devised for use on the IBM-7090 computer. This system obviates the preparation of large amounts of cross section data. It also provides a scheme for rapid access to these tabulated values. (auth)

19240 (TID-15630) AUTOMATIC DATA LOGGING AND COMPUTING SYSTEM PERFORMANCE TEST. Section 1. Test Evaluation, T-641333, DLCS-4000101. (Duquesne Light Co., Shippingport, Penna.). First issue, Dec. 6, 1961. Second issue, Mar. 23, 1962. Contract [AT(11-1)-292]. 40p.

Tests were carried out to check the automatic data logging and computing system to assure that it was not damaged during shipping and/or installation. Results of the tests were satisfactory. (M.C.G.)

19241 (UCRL-10153) A GENERAL PROGRAM FOR STATISTICAL ANALYSIS USING THE MAXIMUM-LIKELIHOOD METHOD. "MALIK" PROGRAM. Fernand Grard (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 30, 1962. Contract W-7405-eng-48. 9p.

A program for analysis of experimental data by the maximum-likelihood method is described. The solution, along with the corresponding error matrix, is determined by a stepping procedure. The program can be adapted easily to any particular problem, by coding two simple subroutines appropriate to that problem. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

19242 (DC-59-9-18) FORMATION OF ALUMINA COATINGS BY VAPOR DEPOSITION. G. R. VanHouten (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Aug. 28, 1959. Contract AT(11-1)-171. 82p.

Vapor deposition of alumina was studied. A graphical summary of accomplishments is presented. The concepts, information, and data suitable to or necessary for developing a workable, effective production process were collected and analyzed. Thermochemical calculations indicated equilibria conditions favorable to the formation of alumina for all temperature and gas compositions of interest. The production of water vapor was shown to be the critical rate determining step in the over-all reaction. The presence of carbon dioxide was shown to depress the thermal conductivity of the gas and thereby decrease the outer boundary film temperature. (Temperature was the primary rate controlling factor in the H_2, CO_2-H_2O reaction.) Carbon dioxide also reduced the diffusivities of H_2O, CO and $(AlCl_3)_n$. Carbon monoxide was shown to have a strongly depressant effect on alumina deposition rates. The reaction of carbon dioxide with graphite to produce carbon monoxide was shown to be a real problem at graphite temperatures above 2000°F. (The reverse reaction between water vapor and carbon monoxide increased rapidly as the temperature rises. High hydrogen concentrations helped by depressing the reverse reaction.) The direct and interaction effects of eight controllable variables on alumina deposition rates were evaluated. A set of operating conditions providing a deposition rate of about 1.1 mils per hour was established. Operating conditions favoring several different crystal forms of alumina were established. The set of operating conditions recommended for the 1.1 mils per hour deposition rate was shown to yield dense, high purity alpha alumina crystals, of about ten microns diameter and with an XRD calculated density of 4.00 to 4.02 g/cm^3. Probable coating stresses were calculated and the consequent effects on performance were reviewed. (auth)

19243 (DC-61-3-34) DEVELOPMENT OF A HIGH STRENGTH BRAZING ALLOY FOR THE AFT RETAINER. Paul R. Mobley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 31, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 62p.

Design and initial stress requirements established for the aft retainer necessitated the utilization of brazing for part joining and the development of a brazing filler to meet stress requirements. A brazing filler was developed which gained a part of its strength through precipitation hardening. The brazing alloy exhibited excellent 1000 hour rupture strength, tensile properties, and oxidation resistance to temperatures of 1700°F. Its brazing temperature is 2150 to 2175°F. The alloy met or exceeded the properties required for service in the aft retainer. Preliminary specifications for application of the alloy to parts manufactured were developed and are reported. (auth)

19244 (EURAEC-20) PRODUCTION OF URANIUM CARBIDE AND MIXED CARBIDES, AS ALSO OF CERMETS MANUFACTURED FROM URANIUM CARBIDE; INCREASE IN THE RESISTANCE TO CORROSION AND THE EXAMINATION OF THE PROPERTIES OF THESE PRODUCTS. Quarterly Report No. 1, May 1 to July 30, 1960. (Appendix II to Letter Addressed to Euratom, Aug. 29, 1960). Paul Himmelstein and Bernhard Liebmann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work performed under United States–Euratom Joint Research and Development Program. Contract [012-60-5RDA]. 13p.

Work was done on developing a method for producing UC by reaction and fusion in arc furnaces. Tests for producing sub-stoichiometric UC showed that it is possible to produce uranium and UC cermets in an arc furnace from mixtures of UO_2 and graphite. A table is given of the carbon content and specific weights of samples produced, which shows the degree of precision possible for obtaining the desired chemical composition. The production of UC powder by grinding is discussed. (B.O.G.)

19245 (EURAEC-69) PREPARATION OF URANIUM AND MIXED CARBIDES AND OF UC-CERMETS, IMPROVED RESISTANCE TO CORROSION AND INVESTIGATION OF THE PROPERTIES. Quarterly Report No. 2, August 1 to October 31, 1960. (Appendix II to Letter to Euratom, Nov. 11, 1960). Paul Himmelstein and Bernhard Liebmann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work performed under United States–Euratom Joint Research and Development Program. Contract 012-60-5RDA. 8p.

A device is described which permits the transfer of a powdery mixture of C and UO_2 from a storage container to an electric arc for the continuous production of UC. The rate of fusion was found to be 70 to 100 g of UC/hr, while another 20 to 30 g was blown away as unconverted powder by the blast of CO produced in the reaction. Microhardness values were determined for two hypo-stoichiometric uranium carbides, $UC_{0.3}$ and $UC_{0.5}$, for the carbide and metal phases. (B.O.G.)

19246 (EURAEC-116) DEVELOPMENT OF CERAMIC FUEL ELEMENTS FOR HIGH TEMPERATURE REACTORS. Quarterly Report No. 2, April–June 1961. (Battelle Institut e. V., Frankfurt am Main). July 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. 18p.

Sintered UO_2 was fabricated without additives in order to determine its thermal conductivity. The characteristics of available UO_2 powders were determined. The O–U ratio was measured by the oxidation method, the specific surface according to the BET method, and the sinterability by means of differential thermal analysis. Pressing and sintering tests were carried out to obtain the conditions for the fabrication of sintered UO_2 with densities of 92 to 96% theoretical. (M.C.G.)

19247 (HW-59653) PROTECTION OF STAINLESS STEEL SHEATHED THERMOCOUPLES FROM URANIUM AT 800°C. J. H. Sako (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 30, 1959. Contract [AT(45-1)-1350]. 4p.

It was found that flame spraying stainless steel sheathed thermocouples with tantalum protected them from reactions with uranium above 700°C. (M.C.G.)

19248 (NP-11628) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Frazier, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 1962. Contract AF33(616)-7747. 51p.

Included are references on high-strength alloys, light metals, nonmetallics and refractory metals. Also included

are references on coatings, applications, and composites. Summaries are included with most references. (J.R.D.)

19249 (NP-11690) THE ANALYSIS OF THE BASIC FACTORS INVOLVED IN THE PROTECTION OF TUNGSTEN AGAINST OXIDATION. Phase III Progress Report, January 15, 1962–March 31, 1962. Michael G. Nicholas and C. Dale Dickinson (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). Apr. 15, 1962. Contract AF33(616)-8175. 29p. (TR-62-110.11)

The progress made in a study of the oxidation behavior of liquid Hf– and Zr–Sn alloys is described. HfO_2 is found to grow parabolically from liquid melts at temperatures as high as 1600°C. Some data on the oxidation behavior of Zr melts were obtained. The implications of the oxidation behavior of the Hf melts are discussed in terms of the future development of ultra-high-temperature coatings. Other liquid metal systems are considered. (auth)

19250 (TID-15414) EFFECTS OF ULTRASONIC ENERGY ON METALS AND ALLOYS. A Bibliography. Lois Godfrey, comp. (Los Alamos Scientific Lab., N. Mex.). Jan. 18, 1957. Contract [W-7405-Eng-36]. 29p. (D-BIB-2)

A bibliography is presented on the effects of ultrasonic energy on metals and alloys. The 183 references cover the period 1952 to 1957, and are arranged in alphabetical order by author. (M.C.G.)

19251 (CEA-tr-R-1453) LA CONDUCTIBILITÉ ÉLECTRIQUE DES OXYDES ET LEUR APTITUDE AU MOUILLAGE PAR DES MÉTAUX LIQUIDES. (The Electric Conductivity of Oxides and Their Aptitude to Wetting by Liquid Metals). V. N. Eremenko and Yu. (W.) V. Naidich (Naiditch). Translated into French from Ukrain. Khim. Zhur., 23: 573-8(1957). 20p. (Includes original, 4p.).

An installation permitting the measurement of the junction angle of wetting and of the surface tension under 10^{-5} mm Hg in a protective atmosphere of inert gas at temperatures from 1650 to 1700°C was designed and constructed. A hypothesis on the existence of a relationship between wetting aptitude ($\cos\theta$) and electric conductivity in oxide–liquid metal systems was expressed on the basis of general consideration and verified experimentally. The wetting aptitude was studied in the systems (Mg, Ni)O–Sn; (Mg, Ni)O–Ag; and (Mg, Ni)O–Cu; $(Al, Cr)_2O_3$–Fe. A good wetting aptitude of liquid Sn, Ag, and Cu at the surface of the solid solutions (Mg, Ni)O, rich in Ni oxide, was detected. On these surfaces 50° to 10° were minimum junction angles at 900 to 1100°C. The wetting aptitude in all the systems increases as a function of electric conductivity. This law can be utilized for selecting the components and the condition for the preparation of a cermet. (tr-auth)

19252 NEW METHOD FOR THE INTRODUCTION OF RARE GASES INTO METALS. Gilbert Brebec, Viviane Lévy, Michel Bendazzoli, and Yves Adda. Compt. rend., 254: 1794-6(Mar. 5, 1962). (In French)

The mechanism for the introduction of rare gases into metals by electric discharge is defined. This led to the modification of the crossed cathode technique. The method proposed has permitted large metallic surfaces loaded homogeneously with gas to be obtained. (tr-auth)

19253 EQUILIBRIUM IN THE REDUCTION OF BERYLLIUM OXIDE WITH CARBON. F. Sh. Muratov and A. V. Novoselova (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 143: 599-602(Mar. 21, 1962). (In Russian)

In investigating the reaction BeO(solid) + $\frac{3}{2}$ C (charcoal) = $\frac{1}{2}$ Be_2C (solid) + CO (gas) at 1800 to 2000°C, the reaction components BeO and charcoal were preliminarily degassed by sintering in a vacuum of about 1×10^{-4} mm Hg at a temperature of 1900 to 2000°C. The BeO and charcoal mixture was then pressed into briquets in a graphite die at 1200°C. It was assumed that the reaction had attained equilibrium when the pressure remained constant for 6 to 8 hours. The amount of Be_2C formed was calculated from the pressure of CO in the system and from the amount of methane found on hydrolyzing the carbide with caustic. The equilibrium constant K was found to vary with temperature as follows: $\lg K = (9.021 \pm 0.092) - (20712 \pm 222)/T$. It follows that ΔH^0_T at 1800 to 2000°K = 94.8 ± 1.0 kcal/mol BeO and ΔS^0_T at 1800 to 2000°K = 41.28 ± 0.42 entropy units. The free energy varied with temperature as follows: $\Delta Z^0_T = 94778 - 41.28T$. By using literature values for the heat capacities involved, it is found that $\Delta H^0_{298} = 98.1$ kcal/mol, $\Delta S^0_{298} = 44.08$ entropy units, and $\Delta Z^0_{298} = 85.0$ kcal/mol. The standard heat of formation for Be_2C is ΔH^0_{298} (Be_2C) = −32.8 kcal/mol and the standard entropy is S^0_{298} (Be_2C) = 4.36 entropy units. (TTT)

19254 RECENT DEVELOPMENTS IN THE PRODUCTION AND UTILIZATION OF CERTAIN METALS OF INTEREST IN REACTOR TECHNOLOGY. Jozsef Halzl. Energia és Atomtech., 14: 566-9(Dec. 1961). (In Hungarian)

Developments in reactor technology resulted in fundamental changes in the production of several metals which previously had only a lesser importance. Of course, U and Th are of special importance in this respect as they represent the fuel material of current and planned reactors. In the compilation of economic data, the Communist countries are omitted as no official information has been published in this field. The Th reserves, of special importance for breeder reactors, are estimated at 300,000 tons for India, 210,000 tons for Canada, 200,000 tons for Brazil, 50,000 tons for the United States and Australia, and lesser amounts for South Africa, West Africa, and Nyassaland. The largest treatment plants are in the U.S., in addition to others in Canada, India, and Brazil. The problem of breeding is pursued very actively in the U.S. and in Western Europe. The importance of Be is due to its low absorption cross section and high melting point; it is used both in the form of metal and the refractory oxide. The world production of beryl (containing 10 to 15% BeO) increased from 1700 tons in 1946 to 10,200 tons in 1957; Brazil, Argentina, Mozambique, the Congo, and India are the chief producers. The future of the metals is greatly dependent on its price structure. In Europe, the first Be plant was established in England. Zr presents the advantage of low thermal neutron absorption cross section and high corrosion resistance. Its production also increased considerably during the last 10 years. (TTT)

19255 PREPARATION OF Mg–Zr AND Mg–Th ALLOYS WITH EMPHASIS ON REDUCTION OF TETRACHLORIDES BY Mg. Bruno Beyer and Hellmuth Seliger. Freiberger Forschungsh., B58: 38-45(1961).

Alloying of Mg melts under salt slags at 700 to 800°C using tablets of pressed $ZrCl_4$ and $ThCl_4$ powder which are submerged and reduced in the liquid Mg or stirring tablets of pressed Th powder into the melt is described. Physical and mechanical properties including heat resistance and microstructure are evaluated. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19256 PLASMA TORCHES. Thomas B. Reed. Intern. Sci. and Technol., No. 6, 42-8(June 1962).

The limitation that molecular dissociation sets on the temperatures achievable through combustion can be circumvented by using electrical heating methods. This was

done in welding arcs, but the electrodes required for such discharges imposed many limitations. These were overcome in part by the d-c plasma torch, essentially an arc discharge with a hole cut in one of the electrodes. This radiofrequency electrodeless discharge operating with argon gas can reach temperatures above 20000°K with outputs of several kilowatts. Both 2.5- and 10-kw generators operating at a standard induction-heating frequency of 4 megacycles were used; over half of the power supplied ends up in the plasma. Applications include growing crystals, spraying coatings, spectroscopy, and high-temperature chemistry. (auth)

19257 HOW TO HEAT TREAT BERYLLIUM COPPER. Joseph B. Kuhn (Beryllium Corp., Reading, Penna.). Metal Progr., 81: No. 6, 87-91(June 1962).

Annealing and age hardening (the standard two-step thermal treatment for beryllium–copper alloys) are outlined and discussed. Phase studies are illustrated by a phase diagram and crystal structure photos. Age hardening characteristics are illustrated by ultimate tensile strength-temperature-time graphs. (N.W.R.)

19258 POSSIBILITIES FOR THE APPLICATION OF NONFERROUS METALS IN REACTOR TECHNOLOGY. D. Dimpel. Metall, 16: 214-18(Mar. 1962). (In German)

A survey is presented on the utilization of nonferrous metals in reactor technology. The reactor components discussed are fuels, cladding materials, structural materials, and absorbent materials. The elements considered are U, Pu, Th, Mg, Be, Zr, Al, Nb, V, Mo, BeO, B, and Hf. (J.S.R.)

19259 INVESTIGATION ON THE REMOVAL OF THE CHARGE FROM IRRADIATED OBJECTS BY SUPPLEMENTARY IRRADIATION WITH SLOW ELECTRONS. H. Mahl and W. Weitsch (Carl Zeiss, Oberkochen/Württ, [Ger.]). Z. Naturforsch., 17a: 146-50(Feb. 1962). (In German)

In the irradiation of thin insulating foils with fast electrons, charges occur which do not affect the electron microscopic image, but cause very considerable interferences in the shadow image (flicker effect) and in the investigation of small-angle diffraction phenomena. By supplementary irradiation with slow electrons, according to irradiation conditions and the residual gas pressure present, the charges were either removed or amplified, which leads to various phenomena especially in the shadow image. (tr-auth)

19260 SPECIAL CERAMICS. Proceedings of a Symposium held at the British Ceramic Research Association. P. Popper, ed. New York, Academic Press, Inc., 1960. 380p. $10.50.

Twenty-one papers are included; separate abstracts have been prepared for 7. Included in the papers not abstracted is information on ductility of ceramic materials; a high-temperature creep machine; preparation, properties, and structure of silicon nitride, silicon carbide, phosphorus–nitrogen compounds, molybdenum disilicide, molybdenum disilicide–alumina, calcium fluoride, and cadmium sulfide; heterogeneity and properties of ceramics; determination of nitrogen in refractory nitrides; compacting of powders using moulds made from reversible gels; and carbon tube and electric furnaces. Separate subject and author indexes are given. (P.C.H.)

19261 RELATIONS BETWEEN PROPERTIES AND STRUCTURE. S. N. Ruddlesden. p.3-25 of "Special Ceramics." New York, Academic Press, Inc., 1960.

Discussion is given on how far the properties of new ceramic materials can be predicted from theoretical ideas, their crystal structure, and the positions of the constituent elements in the Periodic Table. The properties discussed include the various mechanical properties, such as strength, hardness, machinability; thermal expansion and conductivity; electrical conductivity; and thermoelectricity, with reference to the supply of power. The nitrides of silicon, aluminium, and boron are used in illustration, and boron phosphide, BP, is discussed, as a new member of the Group III–V series of semiconducting compounds of zinc blend or diamond type structure. (auth)

19262 DEVELOPMENTS IN THE MEASUREMENT OF THERMAL CONDUCTIVITY. T. W. Lindop. p.51-75 of "Special Ceramics." New York, Academic Press Inc., 1960.

Four methods of thermal conductivity measurement used in the control of industrial production are described: a room temperature divided-bar method allows measurements of disks to be made in about ½ hr; at higher temperature (500–700°C) a divided-bar method requires about a day for measurement at one particular temperature; a high temperature (300–1000°C) comparative method carried out in an inert atmosphere allows disks of oxidizable materials, such as carbon, to be measured in a day; and a rapid dynamic method was developed for heating bars (1 cm × 1 cm × 4 cm) instantaneously to 140°C at one end by placing them on a bath of liquid metal and measuring the rate of temperature rise of the other end. The time to reach half the final temperature determines the diffusivity of the material. (auth)

19263 THE EFFECTS OF REACTOR IRRADIATION ON CERAMIC MATERIALS. F. J. P. Clarke. p.82-101 of "Special Ceramics." New York, Academic Press Inc., 1960.

Mechanisms by which reactor irradiation can modify ceramic materials are described. The mechanisms are then critically examined in the light of observed changes. A summary is given of known irradiation induced changes in various properties of such materials, in both single crystal and polycrystalline form. (auth)

19264 COMPOUNDS IN THE SYSTEM Be_3N_2–Si_3N_4. A. Rabenau and P. Eckerlin. p.136-43 of "Special Ceramics." New York, Academic Press Inc., 1960.

Preparation of the specimens requires a special technique which is described and which has a wide range of application to other investigations. The system was investigated between 1600 and 2000°C. There exists a new hexagonal modification of Be_3N_2 which dissolves up to 7 mol % Si_3N_4. Further compounds in the system are Be_4SiN_4 and the wurtzite type compound $BeSiN_2$. (auth)

19265 THE PREPARATION AND PROPERTIES OF BORON NITRIDE. T. A. Ingles and P. Popper. p.144-67 of "Special Ceramics." New York, Academic Press Inc., 1960.

A summary of the known methods of preparation of hexagonal boron nitride is given and the preparation of powder by the reaction of a mixture of boric oxide and calcium orthophosphate with ammonia at 900°C is treated in detail. To obtain pure boron nitride (>99%), the product of the above reaction must be given a further heat treatment at 1800°C. Pure boron nitride cannot be hot pressed, but with impurities or additions (5–20%) densities of 2.0–2.15 g/cm^3 are obtained (theoretical, 2.27 g/cm^3). The physical and chemical properties are summarized; those of hot pressed boron nitride depend on the amount and nature of the additives. The outstanding features of boron nitride are: low dielectric constant and losses, low

thermal expansion, low friction, high thermal conductivity and temperature stability, chemical inertness, good machinability, high electrical resistivity, and neutron absorption. (auth)

19266 THE THERMODYNAMICS OF METAL SILICIDES AND SILICON CARBIDE. P. Grieveson and C. B. Alcock. p.183-208 of "Special Ceramics." New York, Academic Press Inc., 1960.

Experimental methods available for studying the chemical stabilities of metal silicides and the thermodynamics of dilute solutions of silicon in liquid metals and alloys are reviewed. The vapor pressure of silicon was measured using the Knudsen effusion and gas transportation techniques; thr free energy of evaporation of silicon is given by $\Delta G = 96000 - 28.08T$ cal. The dissociation pressures of the cubic and hexagonal modifications of silicon carbide were measured and the following equations for their free energies of formation from gaseous silicon and solid carbon were derived $SiC(hex) \rightarrow Si(g) + C(s) : \Delta G = 120500 - 35.76T$ cal and $SiC(cub) \rightarrow Si(g) + C(s) : \Delta G = 121000 - 36.00T$ cal. The dissociation pressures and heats of formation of metallic silicides are reviewed, and the calorimetric data are correlated with the heats of formation derived from the dissociation pressures of previous workers, using the present heat of sublimation of silicon. Some results are given for the thermodynamics of silicon in pure molten metals and binary alloys. (auth)

19267 HOT PRESSING REFRACTORY HARD MATERIALS. J. S. Jackson and P. F. Palmer. p.305-28 of "Special Ceramics." New York, Academic Press Inc., 1960.

Description is given of an apparatus designed for hot pressing small specimens of refractory hard materials in powder form to a high density using a graphite die heated by passing a high current through the die wall. The progress of densification during the hot pressing of a wide variety of hard materials was followed by recording the contraction of the specimen. (auth)

19268 METALLURGY AND FUELS. VOLUME 4. METALLURGY OF NUCLEAR REACTOR COMPONENTS. H. M. Finniston and J. P. Howe, eds. Progress in Nuclear Energy. Series V. New York, Pergamon Press, 1961. p.477-910. $15.00.

Twenty-four papers are presented on the metallurgy of reactor components. The topics include information on the fabrication of solid fuel elements; stability of fuel elements under irradiation; moderator behavior; cladding properties of carbide coatings, magnesium, niobium, and zirconium; properties of neutron-absorbing materials for control systems; corrosion of plutonium and uranium; and mechanisms for the swelling of irradiated uranium. (N.W.R.)

19269 PROCEEDINGS OF THE THIRD SYMPOSIUM ON ELECTRON BEAM PROCESSES, MARCH 23, AND 24, 1961, BOSTON, MASSACHUSETTS. R. Bakish, ed. Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961. 385p.

Twenty-one papers are included; separate abstracts have been prepared for seven. The papers give information on the direction in which electron beam applications technology is progressing. The topics covered include: welding, heating, electron beam theory, equipment, microminiaturization, ion beam theory, and properties of materials treated with electron beams. (N.W.R.)

19270 PHYSICS OF ION BEAMS. Richard J. Connor (High Voltage Engineering Corp., Burlington, Mass.). p.89-101 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961.

With the advent of research in thermonuclear power generation and in increasing use of particle accelerators in research and industry, the generation and handling of intense ion beams of positive ions is assuming increasing importance. The problems encountered in handling the ion beam are discussed. (auth)

19271 ELECTRON BEAM WELDING IN FRANCE. J. A. Stohr (Commissariat à l'Énergie Atomique, Saclay, France). p.102-15 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961.

Electron beam welding of reactor fuel elements is described. A number of experimental systems used in the Saclay group are discussed. (auth)

19272 ELECTRON BEAM WELDING AT HIGH VOLTAGES (100,000–150,000 VOLTS). H. H. Hoffman (Olin Mathieson Chemical Corp., New Haven). p.116-44 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961.

Data on electron beam welding with a high voltage system are presented. Materials processed were Zircaloy, Inconel, stainless steels, aluminum, 1100 and 2024 aluminum alloys, niobium, and tungsten. (auth)

19273 ELECTRON BEAM WELDING OF BERYLLIUM. W. T. Hess, H. J. Lander, and S. S. White (Alloyd Electronics Corp., Cambridge, Mass.). p.167-88 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961.

An electron beam system for welding beryllium and the results obtained with it are discussed. Emphasis was placed on obtaining welds with shallow penetration and with strengths equivalent to the parent metal. (auth)

19274 IRRADIATION "FACTOR-DEPENDENCY:" SOME PARAMETERS FOR VINYL MONOMERS. Ed. F. Degering (Quartermaster Research and Engineering Command, Natick, Mass.), Charles Merritt, Jr., M. L. Bazinet, and E. F. Grey. p.212-25 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961.

Studies on radioinduced polymerization effects on monomer systems have shown that: the effect on parameters is dependent on the monomer system, molecular weight of the polymer may be a function of both dose rate and temperature, benzene as a diluent in the systems studied served as a moderator, and reaction rate, $kI^{\frac{1}{2}}$ is not applicable for the parameters used in these studies. (auth)

19275 METHODS AND TECHNIQUES FOR EVALUATION OF CHEMICAL CHANGES IN MATERIALS UPON ELECTRON BEAM RADIATION. Charles Merritt, Jr. (Quartermaster Research and Engineering Center, Natick, Mass.). p.226-37 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1961.

An important use of electron beam radiation is for the preservation of food. The destruction of bacteria is, unfortunately, accompanied by chemical changes in the food which sometimes alter its flavor. Some aspects of radiation preservation of food and the chemical changes which occur will be discussed along with the methods and techniques which are used to evaluate them. (auth)

19276 ELECTRON BOMBARDMENT EVAPORATION OF TANTALUM FOR THIN FILM COMPONENTS. R. W.

Berry (Bell Telephone Labs., Inc., Murray Hill, N. J.). p.358-66 of "Proceedings of the Third Symposium on Electron Beam Processes." Cambridge Massachusetts, Alloyd Electronics Corporation, 1961.

Thin film components based on tantalum were, until recently, prepared by cathodic sputtering. An investigation was made to determine differences in properties between films deposited by evaporation and sputtering. The design of the evaporation apparatus and the properties of the films produced are described. It is concluded that there are no significant differences between films produced by evaporation and sputtering. (auth)

19277 RESPONSE OF METALS TO HIGH VELOCITY DEFORMATION. Proceedings of a Technical Conference Estes Park, Colorado, July 11-12, 1960. P. G. Shewmon and V. F. Zackay, eds. Metallurgical Society Conferences. Volume 9. New York, Interscience Publishers, 1961. 501p.

Eighteen papers are included on the response of metals to high velocity deformation. Primary emphasis is placed on the mechanism of deformation caused by high pressure shock waves. Information is also given on techniques and equipment used in analyzing deformation. Experimental results and major problems which are impeding understanding of the effects are analyzed. (N.W.R.)

19278 PROCEEDINGS OF THE FOURTH SYMPOSIUM ON ELECTRON BEAM TECHNOLOGY, MARCH 29 AND 30, 1962, BOSTON, MASSACHUSETTS. R. Bakish, ed. Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. 536p.

Twenty-six papers are included; separate abstracts have been prepared for six. One paper is in German. The papers give information on the direction in which electron beam applications technology is progressing. The topics covered include: electron beam theory, equipment, welding, melting, and properties of materials treated with electron beams. (N.W.R.)

19279 THE USE OF ELECTRON BEAMS AS MEASURING TOOLS IN HIGH VACUUM PHYSICS. C. K. Crawford (Massachusetts Inst. of Tech., Cambridge). p.59-70 of "Proceedings of the Fourth Symposium on Electron Beam Technology." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. (In English)

The use of mass spectrometers and ionization gauges to measure and control processes occurring in high vacuum is discussed. It is shown that the method is very sensitive and extremely versatile but a good method of calibration is currently lacking and a remedy is suggested. New mass spectrometers designed for evaporation control are described. (auth)

19280 ON SOME PROPERTIES OF ELECTRON BEAM MELTED METALS. E. Rexer (Inst. for Applied Physics of Pure Materials, Dresden). p.245-75 of "Proceedings of the Fourth Symposium on Electron Beam Technology." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. (In German)

Systems for electron beam melting and refining of metals are presented. Some properties of nickel, zirconium, niobium, tungsten, molybdenum, tantalum, rhenium, and rhenium–molybdenum alloys processed in these installations are discussed. (auth)

19281 HORIZONTAL ZONE MELTING OF REFRACTORY METALS BY REMOTE GUN ELECTRON BOMBARDMENT. T. Hikido (Oak Ridge National Lab., Tenn.). p.276-83 of "Proceedings of the Fourth Symposium on Electron Beam Technology." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. (In English)

An electron bombardment button and ingot melting furnace was adapted to zone melt refractory metals by designing a water cooled copper cavity of 4¼ in. ID × 7 in. O which can contain approximately 1.2 kg of metal. One of the objectives of the zone melting work is to produce single crystals of refractory metals (especially niobium) for mechanistic studies pertaining to corrosion, oxidation, and deformation. Compared to floating zone melting techniques horizontal zone melting has the advantage of permitting larger specimens to be refined. (auth)

19282 BACKSCATTERED ELECTRONS AS AN ANALYTICAL TECHNIQUE. R. E. Ogilvie (Massachusetts Inst. of Tech., Cambridge). p.299-303 of "Proceedings of the Fourth Symposium on Electron Beam Technology." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. (In English)

When a specimen is irradiated with an electron beam, an x-ray spectrum is produced which is characteristic of the energy of the incident electrons and the elements present in the irradiated area. There is, however, a fraction of the incident electrons backscattered from the specimen. This fraction backscattered is a function of the average atomic number of the irradiated area. The measurement of the backscattered electrons opens up a technique for high resolution chemical analysis. The principles and applications of this technique are discussed. (auth)

19283 ELECTRON BEAM WELDING OF SINTERED ALUMINIUM. J. Van Audenhove, M. Meulemans, and D. Tytgat (Centre d'Études de l'Énergie Nucléaire, Mol-Donk, Belg.). p.431-46 of "Proceedings of the Fourth Symposium on Electron Beam Technology." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. (In English)

It is generally admitted that sintered aluminum, with different oxide contents, is difficult to weld and must not pass through the liquid state in the assembling techniques. Due to its higher energy concentration, electron beam welding for this task was investigated. Work in which C.E.N. and B. Precis guns were used is discussed. (auth)

19284 ELECTRON BEAM WELDING OF ALUMINUM, BERYLLIUM, AND ALUMINA. H. A. Hokanson, W. I. Kern, and S. L. Rogers (United Aircraft Corp., Windsor Locks, Conn.). p.464-95 of "Proceedings of the Fourth Symposium on Electron Beam Technology." Cambridge, Massachusetts, Alloyd Electronics Corporation, 1962. (In English)

Results of electron beam welding high-strength aluminum alloys, pure beryllium, and alumina to itself and to metals are reported. Welding was conducted with a 3 kw high-voltage, high-power density electron beam welding machine. The range of machine parameters utilized in the aluminum welding program were: accelerating voltage to 150,000 v, beam current to 20 ma, and travel speeds to 120 inches per minute. Additionally, various beam oscillation and pulsing conditions were employed. Alloys welded were 7075 and 6061 aluminum and 85, 96, and 99.5% alumina. For the aluminum, particular emphasis was placed on inducing wettability by destruction of the oxide coating in the weld bead area and reduction of fusion-induced annealing or overaging by minimizing energy input through the use of minimal beam diameter and maximum possible welding speeds. For the alumina welding both to itself and to metals, primary emphasis was placed on eliminating cracking by the use of controlled pre- and post-heating. The major emphasis in the beryllium welding was placed on producing welds of maximum strength and ductility by minimizing energy input to the fusion zone. (auth)

Corrosion

19285 (HW-66206) ZIRCALOY-2 CORROSION IN 340°C FLOWING WATER. Interim Report. H. P. Maffei (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 22, 1960. Contract AT(45-1)-1350. 13p.

Experiments are described to determine the effects of high-temperature water on long-term corrosion of Zircaloy-2. Data are included on weight gains in 340°C water and on H pickup. (J.R.D.)

19286 (HW-68037) THE CORROSION OF STRESS RELIEVED, ANNEALED, NORMALIZED, AND COLD-ROLLED A212 CARBON STEEL IN HIGH TEMPERATURE WATER. A. P. Larrick (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 27, 1961. Contract AT(45-1)-1350. 9p.

Corrosion tests were made in a recirculating test loop operating with 290°C, deionized, deoxygenated water at pH 10 to determine the effects of several heat treatments on the corrosion rate of ASTM A212 Grade B carbon steel. The heat treatments were a 700°F stress relief, an 1192°F anneal, a 1450°F anneal, and a 1650°F normalize. These heat-treated samples were compared with cold-worked material. For all heat treatments, including the cold-worked samples, the corrosion rate was found to be 0.15 mils/yr. An analysis of the iron release rate to the water indicated that a high release rate occurs initially for fresh metal surfaces but the release rate is reduced to a linear rate of 0.41 mg/dm^2/day after 500 hr exposure. (auth)

19287 (KAPL-2203) CORROSION OF ZIRCALOY IN CREVICES UNDER NUCLEATE BOILING CONDITIONS. W. Kermit Anderson and M. J. McGoff (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 13, 1962. Contrac W-31-109-Eng-52. 132p.

The MSAR corrosion test loop was used to study the effect of VEE-shaped crevices on the corrosion resistance of Zircaloy under boiling heat-transfer conditions in both ammoniated and lithiated water at pH 10.5. Zircaloy-2 and Zircaloy-4 were compared under identical geometric, thermal, and hydraulic conditions. An effort was made to study the effect of iron oxide crud deposits on crevices of slightly variant geometry. The tests were run at 586 to 587°F (T_{sat} for a pressure of 1390 to 1400 psig). Water velocity was held in the range of 1 to 3 fps. Control was such that the onset of nucleate boiling should, on the average, have taken place at about the middle of the 5-in.-long, thin-walled crevice specimens. Specimens were vertically oriented in an effort to mock up the most common orientation of flow channels in nuclear reactor cores. Heating of specimens was resistive with 60-cycle a-c, at a heat flux of 500,000 Btu/ft^2-hr. The test in ammoniated water was operated successfully for 1000 hr. The test in lithiated water was subject to such drastic corrosion that it had to be terminated at a total exposure of 211 hr. Two factors tended to obscure the results of this test. First, the previously unsuspected release of alumina into loop water during the ammoniated-water test increased the ionic content of stagnant water in the crevices. Boehmite was deposited in these crevices during boiling. Second, the possible slow thermal dissociation of Teflon seals may have produced minute concentrations of fluorine-containing gases that cause accelerated attack on upstream bus bars. Under ammonia pH control, pitting of the Zircaloy specimens and white oxide formation were quite minor. After 1000 hr of testing, the maximum metal penetration found was two mils, observed at the closed edge of a Zircaloy-4 VEE. The maximum penetration depth observed in Zircaloy-2 was one mil. Under lithium hydroxide pH control, penetrations observed were 5.2 and 5.9 mils for Zircaloy-2 and Zircaloy-4, respectively, during the 211-hr test. Hydrogen pickup in the ammonia chemistry environment was negligible for both Zircaloy-2 and Zircaloy-4. Conversely, in the lithium hydroxide environment, drastic hydrogen embrittlement occurred. Extreme segregation of hydride platelets was demonstrated on all specimens exposed to lithiated water; 3100 ppm of hydrogen was found in the Zircaloy-4 VEE specimen compared with 1200 ppm for the Zircaloy-2 VEE in this boiling lithium-chemistry environment. Less corrosion, hydrogenation, pitting, and white oxide formation were observed in both tests on the precrudded, parallel-faced crevice specimens than were seen on either of the comparable noncrudded VEE's. Whether this is attributable to the deposited synthetic crud or to the more open crevice design is not plain from the existing data. It was concluded that either Zircaloy-2 or Zircaloy-4 will undergo crevice corrosion in closed vertical channels under boiling heat transfer conditions at temperatures near 587°F. Much more drastic attack occurred in lithiated water than in ammoniated water. Under either condition, Zircaloy-4 appeared less resistant to attack than does Zircaloy-2. In the presence of lithium hydroxide, extreme hydrogen embrittlement took place with either Zircaloy. However, Zircaloy-4 was more strongly attacked. (auth)

19288 (HW-TR-36) INTENSIOSTATIC AND POTENTIOSTATIC METHODS, THEIR USE TO PREDETERMINE THE CIRCUMSTANCES FOR CORROSION OR NON-CORROSION OF METALS AND ALLOYS. M. Pourbaix and F. Vandervelden. Translated by Liz Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from Corrosion et anti-corrosion, 9: 341-56 (Nov. 1961); ibid., 385-95 (Dec. 1961). 42p.

Intensiostatic, potentiostatic, and potentiokinetic methods were developed for corrosion studies. Thermodynamic interpretation of voltage-current polarization curves determined during electrolysis in stirred solutions is discussed. The circumstances of corrosion and noncorrosion of iron, steels, stainless steels, copper, aluminum, and aluminum alloys were studied. (auth)

19289 CHEMICAL AND ELECTROCHEMICAL PROPERTIES OF A HIGH PURITY STAINLESS STEEL OF THE 18/8 TYPE. Phu Sy Uy, Jean Montuelle, and Jean Talbot. Compt. rend., 254: 1280-2 (Feb. 12, 1962). (In French)

An 18/8 stainless steel, prepared from pure metals and containing only 35×10^{-6} carbon, always has a martensitic structure at room temperature. A study was made of the corrodibility of such an alloy, particularly in hydrochloric acid medium, using chemical dissolution and electrochemical measurements. (tr-auth)

19290 POTENTIOSTAT ELECTROCHEMICAL STUDY OF THE INTERGRANULAR CORROSION OF A STAINLESS STEEL OF THE 18-8 TYPE. Jacques Voeltzel and Jean Plateau (Institut de Recherches de la Sidérurgie, Saint-Germain-en-Laye, France). Compt. rend., 254: 1791-3 (Mar. 5, 1962). (In French)

The evolution of the intensity-potential curves in the activity region was studied for a stainless steel with 18% Cr, 9% Ni, and 0.1% C as a function of the time the sample was held at 750°C after being water-quenched from 1200°C. A generalized corrosion and the formation of intercrystalline pits was observed in the entire activity region. The prin-

ciple of additivity (the recovery of the intensity-potential curves relative to a heterogeneous sample by making, for each potential, the sum of the partial intensities correspond to homogeneous samples having the composition and the surface of the different zones found in the sample studied) was verified. The consequences of this principle for the chromium-poor zones are discussed. (J.S.R.)

19291 THE MECHANISM OF THE CORROSION PITTING OF ZIRCONIUM IN HALIDE SOLUTIONS. V. A. Gil'man and Ya. M. Kolotyrkin (Karpov Inst. of Physics and Chemistry, USSR). Doklady Akad. Nauk S.S.S.R., 143: 640-2(Mar. 21, 1962). (In Russian)

Pit corrosion is thought to be caused by local deactivation of the Zr surface at points where the concentration of halide acquires a certain critical value. Hence, the duration of the activation, induction period, and the density of the anodic polarizing current should depend on the absolute and relative concentration of halide in the solution. Zr electrodes etched with dilute HF were subjected to a constant current density of 5×10^{-4}, 5×10^{-5}, and 5×10^{-6} amps/cm^2 in 0.01 N, 0.1 N, and 1.0 N KBr, 0.01 N, 0.1 N and 1.0 N KCl, and in the mixtures KCl + Na_2SO_4 and KCl + Na_2CO_3. It was found that the length of the induction period decreased by a factor of 10 on increasing the current density by a factor of 10 at constant halide concentration. At constant current density, the length of the induction period decreases with increasing concentration of halide ion. Other electrolytes, which do not activate Zr metal, such as sulfate and carbonate, increase the length of the induction period. The nature of the cation has no noticeable effect on the corrosion process. A Zr electrode with an oxide film has a much shorter induction period (5 to 30 times smaller), because a critical concentration of halide is attained on a few of the more active sections of the surface. (TTT)

19292 THE CORROSION BEHAVIOR OF THE NICKEL–CHROMIUM INCONEL AND OF NIOBIUM ALLOYS IN A PRESSURIZED WATER REACTOR. [PART] I. Warren E. Berry (Battelle Memorial Inst., Columbus, Ohio). Energie nucléaire, 4: 24-39(Jan.-Feb. 1962). (In French)

Corrosion tests on Inconel were made in two simulated reactor waters (primary and secondary). The exposure to primary water took place under static conditions at 150, 288, 360°C, as well as under dynamic conditions at 288 and 343°C in a loop under high flow conditions. Alloys of different compositions were used and were exposed to various thermal treatments. Some samples were stressed, some contained welds, and some were associated to form galvanic couples. For the niobium alloys the tests were made in static water at 315 and 360°C and in water vapor at 400°C under 100 atm. The composition of the alloys, the test conditions, and the experimental results are given in tabular form. In this first section only the studies on Inconel are reported. (tr-auth)

19293 SEMI-FINISHED ALUMINUM FOR USE IN WATER AT HIGH TEMPERATURES. J. Moisan, P. Lelong, and J. Hérenguel. Metall, 16: 181-6(Mar. 1962). (In German)

The utilization of Al in the nuclear industry has led to increasing study of its corrosion and stability properties in water at high temperatures. The most significant of such studies is reported. Corrosion of unalloyed aluminum was first considered. The effect of heterogeneous structures on the corrosion of special alloys and the thermal stabilities of these alloys are considered in some detail. The fritting-extrusion for the preparation of aluminum bodies is reviewed. (J.S.R.)

Fabrication

Refer also to abstracts 19954, 19960, and 19975.

19294 (AD-267448) TITANIUM SHEET ROLLING PROGRAM FOR Ti-8Al-1Mo-1V, Ti-5Al-5Sn-5Zr, AND Ti-7Al-12Zr. Twelfth Bimonthly Report, May 1–June 30, 1961. D. L. Day, D. R. Mitchell, and H. D. Kessler (Titanium Metals Corp. of America. Technical Lab., Toronto, Ohio). Sept. 14, 1961. Contract NOas 59-6227-c. 108p.

Twelve Ti–8Al–1Mo–1V sheets were duplex annealed at 1850°F (5 min) AC + 1100°F (8 hrs) and tested; the results were nearly the same as achieved in laboratory treated samples. The study of the effect of H on 1000°F creep-stability and room-temperature notch properties of Ti–8Al–1Mo–1V showed that 150 ppm H content is a safe level in both mill annealed material. Uniform properties were found to exist through a representative sheet of Ti–8Al–1Mo–1V and a stress relieving investigation showed that temperatures of 1100 to 1300°F are required to relieve residual stresses in short practical times. Laboratory studies on Ti–5Al–5Sn–5Zr and Ti–7Al–12Zr sheets showed that 0.010 to 0.012 in. should be removed from gage after finish rolling to remove processing contamination, particularly in Ti–7Al–12Zr; that 150 ppm H is a safe level for Ti–5Al–5Sn–5Zr; and 100 ppm appears to be tolerable in Ti–7Al–12Zr; and that slow cooling after final annealing adversely affects the creep resistance and ductility, especially the latter in Ti–7Al–12Zr. (auth)

19295 (ASD-TR-7-888(1)) DEVELOPMENT OF ULTRASONIC WELDING EQUIPMENT FOR REFRACTORY METALS. Interim Technical Engineering Report, June 1, 1961 to August 31, 1961. J. Byron Jones, Nicholas Maropis, Carmine F. De Prisco, John G. Thomas, and Janet Devine (Aeroprojects, Inc., West Chester, Penna.). Sept. 1961. Contract AF 33(600)-43026. 65p. (AD-263872)

Joining refractory and superalloy metals in thicknesses up to 0.10 in. by ultrasonic welding is feasible. A first approximation of the acoustical energy required indicates that the requisite welding equipment is also feasible. A compilation and discussion of information pertinent to the development of ultrasonic welding equipment is presented for joining AM-355 steel, Inconel X, René 41, W, Mo–0.5% Ti, and Nb alloy (du Pont D-31). (auth)

19296 (ATL-A-112) INVESTIGATION OF THE TECHNICAL FEASIBILITY OF COLD EXTRUSION FOR ZIRCALOY-2 TUBING PRODUCTION. Quarterly Technical Progress Report, October–December 1960. (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Work performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 7p. (EURAEC-90)

Activities included completion of room-temperature extrusion tests on Zircaloy bar, and extrusions with 50% reduction at temperatures up to 400°C. Results of these tests are tabulated along with results of billet piercing tests at 300°C. It is noted that production of capped Zircaloy tubes by cold extrusion appears promising. (J.R.D.)

19297 (ATL-A-114) DEVELOPMENT OF CLAD CERAMIC FUEL PLATES BY SPRAY-COATING TECHNIQUES. Quarterly Technical Progress Report, October-December 1960. N. E. Weare (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Work

performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 5p. (EURAEC-63)

Activities in a program concerned with development of plasma-jet spray-coating techniques suitable for production of clad ceramic fuel plates are described. Experiments on application of zirconia coatings are also described. A survey of UO_2 powder was conducted to determine its suitability for plasma spraying. Also conditions were established for spraying fused and milled UO_2. The effects of process variables on coating and deposition characteristics were found to correlate. Densities of UO_2 coatings of 75 to 80% were achieved. (J.R.D.)

19298 (ATL-A-119) INVESTIGATION OF THE TECHNICAL FEASIBILITY OF COLD EXTRUSION FOR ZIRCALOY-2 TUBING PRODUCTION. Quarterly Technical Progress Report, January–March 1961. (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Work performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 13p. (EURAEC-91)

Investigations are being made to establish the feasibility of using cold extrusion to produce zircaloy-2 tubular products. Results of 105 bar-extrusion tests are presented. The optimum extrusion temperature appeared to be 300°C, based on lubricant condition and extrusion pressure. Samples in 145 piercing tests were reduced up to 80%. In 46 tube-extrusion tests, reduction to 80% and wall thicknesses to 0.044 in. were achieved. Results of tensile tests, metallographic examination, preferred-orientation studies, and corrosion testing are discussed. (M.C.G.)

19299 (ATL-A-120) INVESTIGATION OF THE TECHNICAL FEASIBILITY OF COLD EXTRUSION FOR ZIRCALOY-2 TUBING PRODUCTION. Quarterly Technical Progress Report No. 3, April–June 1961. F. E. Weil and J. G. Hill (Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.). Work performed under Unites States–Euratom Joint Research and Development Program. Contract AT(04-3)-250. 14p. (EURAEC-139)

Investigations are being made to establish the feasibility of using cold extrusion to produce Zircaloy-2 tubular products. Tests on extruding $1\frac{1}{4}$-in. diameter billets were completed. Samples in 46 bar-extrusion tests were extruded with 80% reduction at 400°C. Severe lubricant breakdown occurred. Piercing tests were conducted at room temperature and 200°C, using 50% reduction and a 140-degree conical punch profile. Good extrusions were obtained in forming 1.07-in. OD × 0.052-in. wall tubes with 65% reduction. Low efficiencies in tube-extrusion tests compared with those for bar extrusion were due to the large surface-to-volume ratio of tubular specimens. Tooling was designed and fabricated to produce, in three steps, 12-in. lengths of 0.560-in. OD × 0.030-in. wall tubing from 0.955-in. diameter billets. (M.C.G.)

19300 (DP-679) KNURLING FUEL TUBE SURFACES. Dee Baker, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Feb. 1962. Contract AT(07-2)-1. 14p.

The inner and outer surfaces of coextruded fuel tubes that have an Al–U core and Al cladding were knurled to improve their burnout heat flux and film coefficient. A special tool was developed to produce a coarse, diamond knurl pattern on the inner surface of long fuel tubes. (auth)

19301 (EURAEC-7) PERFECTING THE SINTERING OF URANIUM OXIDE WITH A VIEW TOWARDS INCREASING ITS THERMAL CONDUCTIVITY. Quarterly Report No. 3, September 15 to December 15, 1960. (Compagnie Générale de Télégraphie sans Fil, Paris). Work performed under United States–Euratom Joint Research and Development Program. Contract 004-60-3RDF. 27p.

Program activities during the period were centered around the fabrication of uranium oxide samples which were sintered with and without additives. Densitometric and spectrographic examinations, and physical measurements including thermal conductivity and microhardness were also made. (J.R.D.)

19302 (EURAEC-8) REPORT ON THE PRODUCTION OF SWAGED OXIDE FUEL ELEMENTS. Quarterly Report No. 1, May 1 to July 30, 1960. Friedrich Hofmann and Bernhard Liebmann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Aug. 29, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract 011-60-5RDA. 8p.

During swaging tests with ground and melted UO_2, the powder was compressed to 95% theoretical density. Similar tests were conducted using Al_2O_3 powders to resolve certain questions on the compressibility of the ceramic powders, rapidly and without the use of extensive dust protection measures. Characteristics determined from the tests are tabulated. (B.O.G.)

19303 (EURAEC-9) HOT SWAGING OF URANIUM OXIDE FUEL ELEMENTS. Quarterly Report No. 2, August 1 to October 31, 1960. Friedrich Hofmann and Bernhard Liebmann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work performed under United States–Euratom Joint Research and Development Program. Contract 011-60-5RDA. 10p.

A study was made of the effects of the bore size and stroke of the stamper on the stamp-density of UO_2. Sintering at high temperatures and chemical treatment were found to cause the bulk- and stamp-density to be increased. (B.O.G.)

19304 (EURAEC-11) SWAGING OF URANIUM DIOXIDE. Quarterly Report No. 2, August 1 to October 31, 1960. (FIAT. Sezione Energia Nucleare, Turin). Nov. 30, 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract [013-60-5RDI]. 45p.

An investigation of fused UO_2 powder (Spencer swageable grade) undertaken previously was continued. Fabrication of core-length rods is reported. In the best specimen obtained UO_2 density reached 89.6 ± 1% of theoretical. An investigation of gamma-absorption density determination of rods is being carried out according to schedule. Preliminary measurements of the thermal conductivity of swaged UO_2 showed values much lower than those attributed to pellets of corresponding density. (auth)

19305 (EURAEC-56) STEAM SINTERING OF URANIUM DIOXIDE. Quarterly Progress Report No. 2, December 1, 1960–March 31, 1961. (FIAT. Sezione Energia Nucleare, Turin). Apr. 30, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract [016-60-9RDI]. 20p.

The uranium oxide pellet plant was completed, and uranium oxide pellets with satisfactory properties are being obtained. The construction of the steam sintering experimental plant is almost complete. The thermodifferential analyzer was developed and used for determining some of the properties of the powder which will be used at a later stage. A thermodifferential analysis experiment in steam was developed and is being carried out. A certain amount of U_3O_8 oxide was prepared, and is to be used for making the mixtures which will be subjected to

various tests and for the determination of the sintering activation energy. (auth)

19306 (EURAEC-253) SWAGING OF URANIUM DIOXIDE. Quarterly Progress Report No. 6, October 1, 1961 to December 31, 1961. (FIAT. Sezione Energia Nucleare, Turin). Jan. 31, 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract 059-61-7RDI. 16p. (FN-E-17).

A series of 24 bars of reactor core length and 11 mm in diameter were fabricated with the vibro-swaging process previously developed. The fused UO_2 cladded in stainless steel was vibrated to approximately 84% T.D. and swaged with 2 passes for a total reduction of area of 16%. Densities of 93 and 92.5% of theoretical were obtained for tube wall thicknesses of 1.0 and 0.5 mm respectively. Reproducibility of density resulted in better than 0.5% T.D. Preliminary data on uniformity of density along the rod length also indicated a satisfactory value (±0.5% T.D.). Rod elongation was limited to a maximum 11% with final active length of (126 ± 1) cm for the 0.5 mm wall thickness. In swaging-annealing experiments, densities up to 80% of theoretical were obtained with a mixture of fused and ceramic grade UO_2 (56 wt % of ceramic grade). Fragmentation of fused UO_2 during vibration and swaging and roughness of inner surface of cladding in contact with swaged UO_2 were studied. (auth)

19307 (NOR-61-236) PROGRAM FOR THE DEVELOPMENT OF EXTRUDED BERYLLIUM SHAPES. Interim Engineering Report No. 13, June 1, 1961–August 31, 1961. L. M. Christensen (Norair. Div. of Northrop Corp., Hawthorne, Calif.). Contract AF33(600)-36931. 63p. (AD-265935).

Successful completion of Phase I extruding development demonstrated techniques by which aircraft structural shapes can be extruded from pure Be. Pilot production of five 20-ft lengths of a 0.12 × 1.0 × 1.5-in. structural channel proved acceptability and reproducibility of the developed process. Excellent dimensional integrity and surface quality, consistent freedom from defects, and high strength with relatively high ductility were achieved in pilot production. The prime contributing factor to this success was the change of technical approach from the glass lubrication system to a newly developed refinement of the canned or clad technique designated the composite lubricant system. (auth)

19308 (PWAC-165) FEASIBILITY INVESTIGATION OF ULTRASONIC WELDING AS A MEANS FOR JOINING HEAT EXCHANGER COMPONENTS. Final Report. J. E. Meinhardt (Aeroprojects, Inc., West Chester, Penna.). Oct. 1956. For Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn. Contract AT(11-1)-229. 51p. (RR-56-50)

The feasibility of welding type 316 stainless steel, Inconel, and Inconel X materials in sheet gages ranging from 0.005 to 0.020 in. by means of ultrasonic spot-type welds was successfully demonstrated. Tensile-shear evaluation of the welds produced in type 316 stainless steel showed strengths substantially above MIL-W-6858 specifications for resistance-type spot welds in this material and strength scatter well within the limits prescribed in these specifications. Further investigations were carried out with type 316 stainless steel in which panels of this material were seam welded with an ultrasonic roller-type welder. Following thermal treatment, tensile-shear strength testing of such seam welds resulted in fracture of the parent metal rather than the weld. Ultrasonic seam welding of type 316 stainless steel panels to corrugated sheets was accomplished by means of a specially designed sonotrode tip and clamping arrangement. Metallographic examination of these welds showed good bonding characteristics. (auth)

19309 (TID-15624) EQUIPMENT FOR SINTERING OF THORIA AND THORIA GELS. Technical Report No. XV. A. U. Daniels and M. E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Apr. 2, 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 1075. 15p.

Suitable high and low temperature furnaces were designed and constructed for sintering studies. A method for following sintering continuously through recording linear shrinkage with a linear variable differential transformer was devised and proved successful. Initial data for sintering of thoria prepared from thorium oxalate were obtained and are included. (auth)

19310 (WADD-TR-60-418(Pt.III)) DEVELOPMENT OF OPTIMUM METHODS FOR THE PRIMARY WORKING OF REFRACTORY METALS. P. S. Duletsky and V. DePierre (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). Oct. 31, 1961. 30p.

Extrusion techniques and processes were developed to provide wrought materials. These techniques and processes helped to expedite alloy development programs in refractory metals. Improved lubrication techniques using Corning 7900 glass mixtures were developed for extruding refractory metals at 4000°F. The suitability of zirconium oxide ceramic coated steel dies for extrusion at 4000°F was confirmed. Improved extrusion techniques give reproducible, good quality, round and rectangular bar extrusions at temperatures up to 4000°F and reduction ratios of 9.5 to 1. (auth)

19311 (EURAEC-60) FABRICATION OF OXIDE-BASED FUEL ELEMENTS BY SWAGING. Quarterly Progress Report No. 3, January 1–March 31, 1961 [on] HOT SWAGING OF URANIUM OXIDE FUEL ELEMENTS. Appendix 2 to Letter of May 17, 1961 to Euratom, Brussels. F. Hofmann and B. Liebmann (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). May 17, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 011-60-5RDA. 15p. A translation.

Hot-swaging tests were carried out in the 450 to 900°C temperature range. The swaging densities thus achieved were, according to the UO_2 powder used, from 4 to 7% above those obtained under comparable conditions by cold swaging. Powder prepared by melting and grinding was sucessfully compacted to 94% theoretical density by a 53% cross-sectional reduction at 800°C, while powder fabricated chemically was compacted to 87.5% theoretical density by a 65% reduction at 600°C. The interdependence between the pore structure of swaged UO_2 and the type of powder, swaging temperature and cross-sectional reduction was examined by means of a mercury porosimeter. (auth)

19312 WELDING FEASIBILITY STUDY OF A THICK WALLED, CARBON STEEL PRESSURE VESSEL. T. E. M. Jones (Wrightson and Co. Ltd., Thornaby-on-Tees, Eng.) and J. D. Marshall. Brit. Welding J., 9: 180-7 (Apr. 1962).

To assess the problems involved in the fabrication of a 0.35% C steel reactor vessel shell of thickness up to 8 in., full-scale tests on weld details were undertaken. Branches set in and on the shell with weld thickness up to 5½ in., welded manually using low-hydrogen electrodes, showed sound welds with 100°C preheat. Butt welds in 4, 5½, and 8 in. plate, using the submerged-arc method, showed sound

welds provided that a balanced welding sequence and preheat of up to 150°C was maintained. Four submerged-arc deposit compositions were investigated. Destructive examination showed that cold cracking in the weld metal or heat-affected zone was found where preheat was inadequate or when a weld deposit over-matching the tensile strength of the plate was used. The deposit most suitably matching the plate properties and giving no welding difficulty contained 0.09% C and 2.09% Mn. A test using the electro-slag process showed no apparent difficulty when welding this steel, and demonstrated the large economic savings to be obtained with the process. (auth)

19313 WELDING IN A CO_2 GAS COOLED REACTOR PRESSURE CIRCUIT. A. J. T. Clements (John Thompson Ltd., Wolverhampton, Eng.). Brit. Welding J., 9: 188-98 (Apr. 1962).

The development of suitable weld joints, the training and testing of operators, and preparations for welding are discussed in order to describe some of the more interesting welding operations which occur in the fabrication of a cylindrical type CO_2 gas cooled reactor pressure vessel. (auth)

19314 FABRICATION OF HEAT EXCHANGER SHELLS FOR BRADWELL NUCLEAR POWER STATION. T. E. M. Jones (Wrightson and Co. Ltd., Thornaby-on-Tees, Eng.) and B. K. Twigg. Brit. Welding J., 9: 199-206(Apr. 1962).

Weld testing and heat treatment of the 12 large pressure vessels are discussed. Tests disclosed weld cold cracking at certain joints and methods were derived to overcome these difficulties. An account is given of testing, production, and stress relief of the heat exchanger shells. (auth)

19315 WELDING AND INSPECTION OF STAND PIPES FOR NUCLEAR POWER REACTORS. T. J. H. Webborn. Brit. Welding J., 9: 206-11(Apr. 1962).

Suitable joint designs and methods of welding stand pipes to reactor pressure vessels are described. A discussion is given on defects that may occur and how they can be overcome. (auth)

19316 CONSTRUCTION OF GAS COOLED REACTOR PRESSURE VESSELS. W. C. Holliday. Brit. Welding J., 9: 291-300(May 1962).

Factors associated with reactor pressure vessel construction are considered. Reasons are given for selecting plates having a guaranteed minimum Charpy V-notch impact value of 35 ft-lb at −10°C, and reference is made to the properties of forgings rough forged to final shape. Weld tests to qualify manual and submerged-arc welding of thick plates are described. It is shown that plates hot pressed to a controlled procedure have properties equal to or better than plates in the normalized condition, and that these properties are affected by a long soaking time at the stress-relieving temperature. The determination of the temperature for pressure testing, based on transition temperature, is referred to, and the variation in transition temperature of ½-4 in. thick carbon steel plate, as determined by testing Charpy and Tipper specimens, is discussed. (auth)

19317 TUBULAR REACTOR ELEMENTS AND METHODS FOR THEIR MANUFACTURE. (to Deutsche Babcock & Wilcox-Dampfkesselwerke A. G.). German Patent DAS 1,086,817. Aug. 11, 1960. Kernenergie, 5: 65(Jan. 1962). (In German)

The invention concerns a tubular fuel element that consists of a cermet sandwich (for example, uranium oxide clad with stainless steel) which then also is clad. The fuel element is shaped to a round, oval, or polygonal (preferably six sided) tube. The cut edges are welded with or without electrodes or are soft or hard soldered and the tube interior is filled with moderating material. The cermet layer extends up to the cut edges and is welded flush with the cladding. The cermet layer is prepared first as a flat sheet, cut to dimension, and after bending together, is welded to a tube. Then the prepared tubular elements are provided with a gas tight coating by means of dipping, sputtering, or vacuum deposition. (J.S.R.)

19318 FORGING OF URANIUM. A Review of Literature. P. I. Seredin. Kuznechno-Shtampovochnoe Proizvodstvo, No. 1, 14-18(1961).

A review is given on the preparation of uranium ingots for forging and the peculiarities of uranium in forging preliminary to rolling, extrusion, and drawing. Technological recommendations of foreign sources and details of techniques used at two plants, Keppenstall Steel Co. and Malincrodt are given. It is concluded that alpha uranium is used most. The heating of α uranium prior to forging is most expediently carried out in salt baths; it should be deformed without impact on presses or other machines. The salt film left after salt bath heating should be preserved since it protects the metal from oxidation. (OTS)

19319 MACHINING RADIO-ACTIVE PLUTONIUM. Metalworking Production, 106: 49-51(Jan. 3, 1962).

Precision turning of Pu in inert Ar and N_2 atmospheres using a specially designed glove-box lathe is described. Gas pressure inside box is kept below atmospheric pressure. Materials used in box construction are polyvinyl chloride, perspex, neoprene, and steel. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19320 THE PERFECT WELD IN ZIRCONIUM. J. T. Maloney. Metalworking Production, 106: 50(Jan. 10, 1962).

The use of a portable purge chamber, high purity argon gas shielding, and controlled heat input in the Tig welding of Zr tube sections and fittings to form a 27 ft long coolant tube for a pressurized-water reactor is described. Inspection of the tube for straightness, tolerances, inclusions, porosity, and other weld defects is described. Weld strength, elongation, and hardness are analyzed. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19321 FUSION OF ELECTROLYTIC URANIUM. R. Chazot and G. Cabane (Centre d'Études Nucléaires, Saclay, France). Vide, 16: 333-4(Nov.-Dec. 1961). (In French)

Uranium obtained by electrolysis has the appearance of more or less ramified dendrites. In this state the uranium is easily oxidized because of the large surface exposed to the air. Fusion is a possible method for making the uranium more compact. A detailed description is given of the procedure for the electron-beam fusion of electrolytic uranium. An analysis of the fused metal shows that there is no difference in the concentration of metallic impurities except for potassium and lithium, whose concentrations are reduced. (J.S.R.)

19322 THE BRAZING OF GRAPHITE. R. G. Donnelly and G. M. Slaughter (Oak Ridge National Lab., Tenn.). Welding J., (N. Y.), 41: 461-9(May 1962).

A program was conducted to develop techniques for brazing graphite to graphite and to metals for reactor applications. Prime difficulties are those associated with differences in thermal expansion coefficients. In addition, the requirements of acceptable wetting, high strength, and adequate compatibility with reactor environments must be considered. An experimental brazing alloy containing

titanium and zirconium was found to be an excellent general purpose material since it readily flows on graphite. This alloy appears very attractive for fabricating graphite assemblies for a wide variety of elevated-temperature applications. Brazing alloys in both the gold–nickel–molybdenum and gold–nickel–tantalum ternary systems were also developed which were corrosion resistant to molten fluoride salts. Compositions, which readily wet and flow on graphite and which are suitable for fabricating graphite-to-graphite and graphite-to-molybdenum assemblies were found. Joints at least as strong as the graphite being brazed were produced. (auth)

19323 METHOD OF JOINING METAL CARBIDES TO METAL BASES. (to U. S. Atomic Energy Commission). British Patent 896,651. May 16, 1962.

A method is given for joining UC and/or ZrC to a base of Ta or Nb. The method comprises heating the out-gassed metal base in contact with out-gassed graphite powder at 2000 to 2200°C for ~15 min to carburize the base surface, and sintering the compacted carbide with the carburized base under pressure at 1800 to 2200°C. An example of the method is given in which U^{235} C–ZrC is joined to Ta in the fabrication of a fuel pin for a thermoelectric generator. (D.L.C.)

19324 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF FUEL ELEMENTS FOR NUCLEAR REACTORS. Maurice Gauthron and Jacques Andre Stohr (to Commissariat a l'Energie Atomique). British Patent 896,756. May 16, 1962.

A method for producing a fuel element comprising a plurality of cylindrical fuel rods housed in a sheath is given which results in improved mechanical strength for a given sheath thickness. The method comprises forming a series of fuel rods in which the external diameter of alternate rods is greater than that of the other rods, enveloping the series of rods in a sheath, and deforming the sheath to hold each rod relative to its adjacent rods. The resultant longitudinal buckling of the sheath stiffens the fuel element. (D.L.C.)

19325 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. George Graham Foster (to Babcock & Wilcox Ltd.). British Patent 896,826. May 16, 1962.

A method and an apparatus are described for sealing an end cap to a fuel element containing helium or other gas between the fuel and the can. The method comprises placing the fuel element in a chamber, evacuating the chamber, introducing helium or other gas into the chamber, and welding the end cap to the can. (D.L.C.)

19326 RESISTANCE WELDING. Edward John Keefe (to United Kingdom Atomic Energy Authority). U. S. Patent 3,036,200. May 22, 1962.

A simple method is given for the resistance welding of materials which may be affected by alloying with traces of metals from the welding electrodes. The method comprises interposing a mild steel strip or clip between the workpiece and the electrodes; the strip or clip is of such thickness that the heat generation therein is less than that in the workpiece. One special application of the method is in the welding of magnesium alloy, e.g., Magnox. (D.L.C.)

19327 PREPARATION OF UO_2 FOR NUCLEAR REACTOR FUEL PELLETS. J. M. Googin (to U. S. Atomic Energy Commission). U. S. Patent 3,037,839. June 5, 1962.

A method is given for preparing high-density UO_2 compacts. An aqueous uranyl fluoride solution is contacted with an aqueous ammonium hydroxide solution at an ammonium-to-uranium ratio of 25 : 1 to 30 : 1 to form a precipitate. The precipitate is separated from the mother liquor, dried, and contacted with steam at a uniform temperature within the range of 400 to 650°C to produce U_3O_8. The U_3O_8 is reduced to UO_2 with hydrogen at a uniform temperature within the range of 550 to 600°C. The UO_2 is then compressed into compacts and sintered. High-density compacts are fabricated to close tolerances without use of a binder and without machining or grinding. (AEC)

19328 ZIRCONIUM–TITANIUM–BERYLLIUM BRAZING ALLOY. R. G. Gilliland, P. Patriarca, G. M. Slaughter, and L. C. Williams (to U. S. Atomic Energy Commission). U. S. Patent 3,038,249. June 12, 1962.

A new and improved ternary alloy is described which is of particular utility in braze-bonding parts made of a refractory metal selected from Group IV, V, and VI of the periodic table and alloys containing said metal as a predominating alloying ingredient. The brazing alloy contains, by weight, 40 to 50 per cent zirconium, 40 to 50 per cent titanium, and the balance beryllium in amounts ranging from 1 to 20 per cent, said alloy having a melting point in the range 950 to 1400°C. (AEC)

19329 NUCLEAR FUEL MATERIAL. Walter V. Goeddel (to U. S. Atomic Energy Commission). U. S. Patent 3,041,260. June 26, 1962.

An improved method is given for making the carbides of nuclear fuel material. The metal of the fuel material, which may be a fissile and/or fertile material, is transformed into a silicide, after which the silicide is comminuted to the desired particle size. This silicide is then carburized at an elevated temperature, either above or below the melting point of the silicide, to produce an intimate mixture of the carbide of the fuel material and the carbide of silicon. This mixture of the fuel material carbide and the silicon carbide is relatively stable in the presence of moisture and does not exhibit the highly reactive surface condition which is observed with fuel material carbides made by most other known methods. (AEC)

Properties and Structure

19330 (AD-265421) UNIJUNCTION DEVICES MADE FROM RARE EARTH SEMICONDUCTORS. Quarterly Report No. 2, April 1, 1961–June 30, 1961. Nathan Sclar (Nuclear Corp. of America, Central Electronic Manufacturer's Div., Denville, N. J.). Contract DA 36-039 SC-87392. 29p.

Rare earth hexaborides and nitrides were synthesized and their electrical properties measured at room temperature. Single crystal growth was also attempted. Measurements indicated that the hexaborides are heavily doped semiconductors with high mobilities. They were prepared with both p and n type conductivities and exhibited photovoltaic effects at point contacts. Single crystal growth attempts using the Verneuil technique have so far provided only polycrystalline rods. The nitrides exhibited tendencies at instability in which the nitride is decomposed to the oxide. As with the hexaborides high mobilities were achieved at relatively heavy impurity doping levels. Crystal growth attempts with DyN using the Verneuil method indicated the vapor pressure at its melting point is excessive to allow crystal growth using this technique. (auth)

19331 (AD-266062) THERMOELECTRIC MATERIAL Bi-Monthly Progress Report No. 10, July 1, 1961 to August 31, 1961. Merton H. Brooks (Titanium Alloy Mfg. Div., National Lead Co., Niagara Falls, N. Y.). Contract NObs 78326. 9p.

Discussions are presented on preparation and synthesis of simple oxides (standard series of additions of TiO_2, ZrO_2, SnO_2, PbO_2 to La_2O_3 and Y_2O_3, La_2O_3, UO_2, Nb_2O_5 to CeO_2), multiple oxides (ABO_3- and $-O_4$ type compounds, and $PbNb_2O_6$ and $-_2O_7$). Fabrication of standard ceramic bodies of Li_2TiO_3 with additions of ThO_2 were completed. Sintering conditions, bulk densities and porosities are presented. Standard ceramic bodies of $BaTiO_3$ plus La_2O_3 and Nb_2O_5 were also prepared. The Seebeck coefficients and resistivities at high temperatures are tabulated for Li_2TiO_3 with various additions of Bi_2O_3, or ThO_3, or CeO_2, or Sb_2O_5. (auth)

19332 (ANL-6327) RECRYSTALLIZATION IN ROLLED URANIUM SHEET. Final Report—Metallurgy Program 4.1.5. Lowell T. Lloyd and Melvin H. Mueller (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-eng-38. 45p.

X-ray diffraction measurements of uranium sheet reduced 76% in thickness at room temperature and after annealing at various temperatures indicated that as-rolled and recrystallized materials have different preferred orientations, contrary to previously reported works. The preferred orientations of samples annealed at 380 and 400°C were very similar, but different from that of a set of samples annealed at 450°C. Reannealing at 450°C did not change essentially the preferred orientation established by annealing at 380°C. Dilatometric measurements in directions parallel and normal to the rolling direction and lying in the plane of rolling did not conclusively substantiate the x-ray diffraction measurements. Recrystallization at temperatures from 360 to 450°C of the homogeneously deformed as-rolled structure was characterized by the formation of extremely fine grains in the early stage which later were absorbed by growth of somewhat larger grains. Evidence of ordinary secondary recrystallization was observed in specimens annealed at 600°C. (auth)

19333 (ARF-2198-13) IMPROVED ZIRCONIUM ALLOYS. Summary Report, April 1, 1960–January 31, 1961. D. Weinstein, F. C. Holtz, and R. J. Van Thyne (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 28, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-578. 42p. (EURAEC-89)

The development of zirconium-base alloys possessing exceptionally good corrosion resistance to 680°F water or 750 to 900°F steam and/or improved strength at elevated temperatures is discussed. Approximately 100 binary compositions were prepared and screened by corrosion testing in 680°F water; selected compositions were exposed to 750°F steam. The data obtained indicated promising bases for ternary and quaternary alloys. Related investigations involving zirconium purity and heat treatment for improvement of corrosion properties are proceeding. Hydrogen pickup and mechanical properties will be used as acceptability tests on promising compositions. (auth)

19334 (ARF-2227-5) HIGH TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Bimonthly Report No. 5, February 12, 1962 to April 11, 1962. John J. Rausch and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 8, 1962. Contract NOw 61-0806-c. 22p.

Flame-sprayed nickel coatings were found to have limited self-healing properties over defects 0.005 inch wide. Exposure of intentionally defected V-1 wt % Ti-60 wt % Cb to 2000°F air for six hours produced hardening of the alloy base to a depth of about 0.035 inch. A capacity for tolerating defects was also observed in the siliconized coating. A specimen, similarly defected, showed no adverse effects except in the immediate vicinity of the defect, after 17 hours' exposure at 2000°F. However, hardening occurred to a depth of at least 0.062 inch in the base metal. Oxidation tests at 1200 and 1500°F indicate that silicide coatings on V-1 Ti-60 Cb are not vulnerable to low-temperature, catastrophic attack. Coated specimens have a life of over 500 hours at these temperatures. Elastic deformation at room temperature, at a stress near the yield point, has little influence on subsequent oxidation behavior. Plastic deformation, however, causes the outermost silicide layer to spall from the surface with a resulting sharp decrease in oxidation life. (auth)

19335 (ASD-TR-61-207) CRACK STRENGTH AND CRACK PROPAGATION CHARACTERISTICS OF HIGH STRENGTH METALS. Period Covered August 1, 1960–May 31, 1961. R. H. Christensen and P. H. Denke (Douglas Aircraft Co., Inc., Long Beach, Calif.). May 1961. Contract AF(33)3-616-7444. 249p.

A program is described to obtain engineering data on the crack propagation and residual strength characteristics of structural materials suitable for use in aerospace systems. Results of a fracture testing program for high strength sheet metals are presented. More than 500 sheet stock panels ranging in width from one to 18 in. and in thickness from 0.020 to 0.100 in. were tested. These panels contained centrally located cracks which were generated principally by fatigue loading at various exposure times under a variety of environments. In general the fatigue crack is shown to be a more severe stress raiser than any manufactured notch yet investigated. Fracture strengths of the cracked panels were determined for rupturing temperatures ranging from –340 to 2500°F. The experimental results were studied analytically. A semi-empirical expression for residual strength is derived. This expression is based on a modification of the formula given by Crichlow for the effective width of the plastic zone. An expression for the rate of crack propagation also is presented. The crack rate formula is based on the plastic zone concept, and accounts for the observed approach to infinite cracking rates as the crack length approaches critical. These formulas are shown to agree well with test results and are suitable for design applications. A digital analysis of the elastic and plastic stress and strain distribution in the cracked plate was performed. The analytical method is discussed and results are presented. (auth)

19336 (ASD-TR-61-684) SCALE-UP DEVELOPMENT OF TANTALUM-BASE ALLOYS. Period Covered July 1, 1960 to September 30, 1961. (Battelle Memorial Inst., Columbus, Ohio). Dec. 1961. Contract AF 33(616)-7452. 117p.

Melting and the effects of other processing variables on the quality and mechanical behavior of two selected tantalum-base alloys were studied. The two alloy compositions selected, Ta–10Hf–5W and Ta–30Nb–7.5V, were scaled up to 30-pound ingots and fabricated to sheet using conventional techniques of extruding, forging, and rolling. Mechanical-property data obtained from the sheet in various conditions of heat treatment and after various processing schedules show both alloys to possess good high-temperature strength as well as low-temperature ductility. Reproducibility of properties was also demonstrated. (auth)

19337 (BM-RI-5975) SOME PROPERTIES OF VANADIUM. R. Lincoln, G. Asai, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Jan. 1961. 37p.

Research on the physical and mechanical properties of pure V is described. In the purest metal small quantities of extraneous materials are present. The effects of these materials are examined, with emphasis on O, N, H, and C. (J.R.D.)

19338 (BM-RI-5982) THERMAL EXPANSION AND PHASE INVERSION OF SIX REFRACTORY OXIDES. Clark F. Grain and William J. Campbell (Bureau of Mines. College Park Metallurgy Research Center, Md.). Aug. 1961. 25p.

Thermal expansion and phase inversion measurements are reported on BeO, CaO, TiO_2, ZrO_2, HfO_2, and ThO_2. (J.R.D.)

19339 (BM-RI-5987) COLUMBIUM–VANADIUM BINARY ALLOYS FOR HIGH-TEMPERATURE SERVICE. H. R. Babitzke, G. Asai, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Sept. 1961. 23p.

An investigation to develop an alloy of Nb for use at high temperatures and for nuclear applications is described. The properties of possible alloys were determined, and the more promising ones were selected for further improvement. Criteria for selection were machinability, hardness, workability, tensile strength, and oxidation resistance. Thirteen 100-gram ingots, ranging from 100% Nb to 100% V, were prepared and subjected to various tests. Also included for comparison were Zr and Zircaloy-2. Test results showed that a Nb alloy containing 10 at. % V merits further development. Besides being workable at room temperature, the Nb–10 at. % V alloy has oxidation resistance superior to the other alloys of the series and is also superior to Zr or Zircaloy-2. The latter two materials have comparable neutron-absorption cross sections. The strength and hardness values of the alloys tested were found to increase with increasing V content, reaching a maximum at 50 at. % V and decreasing with further increase in V. This behavior is typical of binary alloys wherein each element will retain any proportion of the other in solid solution. (auth)

19340 (DC-58-2-206) TOPICAL REPORT ON CHROMIUM-BASE ALLOYS FOR FUEL ELEMENT APPLICATIONS. Report of Milestone II for Task 7474. J. A. McGurty (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 27, 1958. Contract AT(11-1)-171. 51p.

Investigations on the use of chromium-base alloys for fuel element applications are summarized. Information relative to the selection of chromium-base alloys in preference to alloys of other elements for this purpose is defined. Considerations bearing on the selection of chromium-base alloys for GE-ANPD fuel element use are listed. The all chromium-base alloy-UO_2 fuel elements which have excellent oxidation resistance and good strength properties are described. The present limitations of this type element are shown to be related to problems associated with fabrication. The clad chromium-base alloy-UO_2 fuel elements are shown to be stable in air to temperatures at least as high as 2300°F. These elements are readily fabricable but have strength limitations. It was concluded that clad chromium-base-UO_2 fuel elements are being processed which should have immediate reactor applications to temperatures several hundred degrees above the maximum operating temperature of Nichrome V-UO_2 fuel elements, and that further chromium research work may be expected to yield fuel elements of even higher temperature usefulness. (auth)

19341 (DC-59-2-83) PROPERTIES OF Cb MODIFIED 80 Ni–20 Cr STRUCTURAL STOCK AND .006-INCH-CLAD FUEL STOCK. G. T. Muehlenkamp (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 29, 1959. Contract AT(11-1)-171. 21p.

The tensile, tensile creep, rupture, bending creep, stress-oxidation, and thermal expansion properties for both Nb modified 80 Ni–20 Cr structural stock and .006-inch-clad fuel stock are given for temperatures up to 2000°F. (auth)

19342 (DC-59-3-207) PRELIMINARY THERMOCHEMICAL CALCULATIONS FOR THE VAPOR PLATING OF ALUMINA. G. R. Van Houten (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 24, 1959. Contract AT(11-1)-171. 21p.

Mathematical thermochemical relationships were derived. Since the thermodynamic aspects of the reaction appear favorable over a very wide temperature range, an analysis of the probable kinetics of the reaction as a function of temperature will be made. A brief heat transfer analysis will also be made. It should be understood that different reagents might have been used as a source of Al^{3+} and O^{2-}. (auth)

19343 (DC-59-4-106) PRELIMINARY CALCULATION ON PLATE OUT OF Al_2O_3 FROM $AlCl_3$, H_2, CO_2, VAPOR. G. R. Van Houten (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 9, 1959. Contract AT(11-1)-171. 26p.

Work is being carried out on a process for vapor plating of alumina. Changes in viscosity, diffusivity, specific heat, thermal conductivity, Reynolds number, Prandtl number, and Grershof number with changes in gas temperature were determined as a function of various starting compositions. (M.C.G.)

19344 (DC-59-12-117) TORSION TEST OF BY-PASS VALVE ROCKER ARM SHEAR SECTIONS. Warren E. Greenwald (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 10, 1959. Contract AT (11-1)-171. 37p.

Tests were conducted on mild steel and Inconel-X specimens to determine the relationship between angle of twist and torque for each type of shear section for the by-pass valve rocker arm when taken to failure. From the test results it appeared that the 60° V grove with radial holes is a satisfactory shear section in that it has a high yield torque, failure torque is not far above that for yield, and the angle of twist at failure is low. (M.C.G.)

19345 (DC-60-12-158) CREEP RATE OF SOME THERMAL INSULATING MATERIALS UNDER 100 PSI LOAD AT 2100°F HOT-FACE TEMPERATURE. S. E. Eckard (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 2, 1960. Contract [AT(11-1)-171] 10p.

The creep rate and thermal conductivity of several thermal insulating materials were determined. "Alsimag 202 and 504" materials had the lowest creep rate, while a "Perlite" base material had the lowest thermal conductivity and specific weight. (auth)

19346 (EURAEC-66) FISSION GAS RELEASE FROM URANIUM DIOXIDE. Quarterly Report No. 1, November 1, 1960–March 31, 1961. (FIAT. Sezione Energia Nucleare, Turin). Apr. 30, 1961. Work performed under United States–Euratom Joint Research and Development Program Contract 021-60-9RDI. 77p.

Methods for fabricating UO_2 pellets were studied. Analysis methods were perfected for characterizing UO_2 powders

and pellets. A hot cell with a lead thickness of 10 cm was designed to contain apparatus for the study of fission gas release. The irradiation element to contain the pellet-holding capsules was designed and its hydraulic test executed. The instrument for extracting the capsules from the irradiation element was designed and constructed. Melting tests of UO_2 pellets were carried out in potassium pyrosulfate. Preliminary reactivity tests were also carried out. (M.C.G.)

19347 (EURAEC-77) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report No. 3 for period ending June 30, 1961. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Work performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 15p.

Work is being carried out to establish the feasibility of UN as a reactor fuel material. Fabrication was completed on all planned irradiation specimens. Thermal conductivity and electrical resistivity were measured in vacuum on a UN specimen over the temperature range 200 to 800°C. Dense UN specimens were exposed to 500°F deionized and degassed water for up to 14 days. The chemical corrosion that occurred was apparently a surface reaction, and the material showed fairly good resistance to corrosion. Values for the solubility of H_2 in UN were measured at 1 atm and 300 to 800°C. Melting and casting of UN was carried out. (M.C.G.)

19348 (EURAEC-239) THE EFFECT OF RADIATION ON THE DUCTILE-BRITTLE TRANSITION IN PRESSURE VESSEL STEELS. Quarterly Report No. 4, October 1–December 31, 1961. E. Anderson, W. Bollmann, D. King, M. Malone, and J. Spreadborough (Battelle Memorial Inst. International Div., Geneva). Work performed under United States–Euratom Joint Research and Development Program. Contract 041-60-12RDS. 54p.

A method of analysis of dislocation networks is described. The method was developed to facilitate the understanding of the complex dislocation arrays observed by transmission electron microscopy. Studies of internal friction are discussed. The construction of a prototype torsion pendulum is described. (auth)

19349 (EURAEC-249) COMPARATIVE TESTS OF RESISTANCE TO THERMAL STRESS ON SINTERED URANIUM DIOXIDE SAMPLES. Special Report No. 2 [on] SINTERED URANIUM OXIDE, SINTERING TECHNIQUES AND BEHAVIOR UNDER IRRADIATION. M. Brandela (France. Commissariat à l'Énergie Atomique, Paris). Dec. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 031-60-10RDF. 24p.

The effects of preparation method on the resistance of sintered UO_2 to thermal stress were investigated. The theoretical considerations and operating techniques for producing thermal stresses are described. Results are presented in tabular form and in graphs. The determinations were only slightly reproducible. It was found that the thermal shock resistance of a sintered, cylindrical sample of UO_2 varies inversely with its diameter. (M.C.G.)

19350 (EURAEC-252) FISSION GAS RELEASE FROM URANIUM DIOXIDE. Quarterly Progress Report No. 4, October 1, 1961 to December 31, 1961. (FIAT. Sezione Energia Nucleare, Turin). Jan. 31, 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract 021-60-9 RDI. 23p. (FN-E-18)

The preparation and selection of UO_2 irradiation samples were completed. First data on characterization of the powders and pellets are reported. Twelve samples were placed in pile for irradiation. Two pellets were studied for fission gas retention ability by means of post-irradiation annealing technique applied to small samples. D' values obtained at 1400°C are reported and discussed. The hot cell assembling was completed. All manipulators and shafts for operating the inside mechanisms were readied. Fission gas apparatus was placed inside the cell and its different components separately tested for operation. (auth)

19351 (EURAEC-268) STEAM SINTERING OF URANIUM DIOXIDE. Quarterly Progress Report No. 5, October 1, 1961 to December 31, 1961. (FIAT. Sezione Energia Nucleare, Turin). Jan. 31, 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract 016-60-9RDI. 38p. (FN-E-19)

The steam sintering experimental setup underwent only very minor changes and worked successfully with few and short interruptions. Data concerning fired density and other properties versus soaking temperature and time are almost complete. It is apparent that densities up to 94% theoretical with little scatter can be reached in less than two hours at temperatures not above 1350°C, but to obtain extremely high densities looks very difficult, if not impossible. A thorough comparison between the properties of steam- and hydrogen-sintered pellets of corresponding densities is in progress and some results are available. Grain growth in steam starts at the comparatively low temperature of 1250°C. Preliminary x-ray data suggest that in UO_2/U_3O_8 mixtures heat treated at 500°C, the U_3O_8 orthorhombic phase disappears and the UO_2 oxidates to cubic or tetragonal phases. A complete set of steam- and hydrogen-sintered pellets covering ranges of fine densities from 8 to 10.5 g/cc was prepared for the radial dependence of density studies. Machining and measurements are in progress. A review of the theory of sintering and some computations of oxygen equilibrium are given. (auth)

19352 (HW-SA-2560) A STUDY OF THE KINETIC AND MECHANICAL PROPERTIES OF A STABILIZED BETA PHASE PLUTONIUM ALLOY (thesis). John Maurice Taylor (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1962. Contract [AT(45-1)-1350]. 72p.

Submitted to the Univ. of Idaho, Moscow.

The elements Sn, Mg, Ti, Zr, Hf, Si, Cd, and U were alloyed with plutonium to determine their effect on stabilization of the beta phase. Zirconium was found to be the most effective. Kinetic studies were conducted on Pu–Zr alloys having 0.24, 0.65, and 1.7 at.% Zr contents. The beta to alpha transformation in the Pu–Zr alloys was somewhat similar to that in unalloyed plutonium. The main difference being that time, temperature, transformation curves of the alloys were shifted to the right as the zirconium concentration increased. It was determined that the amount of beta phase retained at room temperature increased as the zirconium concentration increased. The minimum amount of Zr needed to stabilize the beta phase of plutonium at room temperature was determined to be 2.0 at.%. A 2.4 at.% Zr addition stabilized the beta phase of plutonium at atmospheric pressure from room temperature to 265°C. During mechanical property testing it was determined that the stabilized beta Pu–2.4 at.% Zr alloy was brittle from room temperature to 230°C. Both tensile and compression strengths of the beta stabilized alloy were greater than the unalloyed beta phase of plutonium. A brittle-ductile transition was noted between 130 and 180°C on the Pu–0.65 at.% Zr alloy. Age hardening studies were conducted at room temperature with a Pu–2.4 at.% Zr alloy. A slight aging effect was noted due to the precipitation of an intermetallic

compound. Compression tests on the Pu–2.4 at.% Zr alloy indicated that below 80°C the stabilized beta phase started to transform to alpha phase during the application of compressive loads. (auth)

19353 (IS-440) DETERMINATION OF THERMODYNAMIC FUNCTIONS FOR THE FORMATION OF BINARY INTERMETALLIC PHASES FROM VAPOR PRESSURE MEASUREMENTS. J. F. Smith (Ames Lab., Ames, Iowa). Mar. 1962. Contract W-7405-Eng-82. 29p.

Vapor pressures of magnesium were measured over the binary alloy systems: magnesium–calcium, magnesium–copper, magnesium–nickel, and magnesium–yttrium. The thermodynamic functions associated with compound formation were determined for the eight intermetallic compounds which occur in these four binary systems. In the case of $MgNi_2$ heat capacity data were available for an extensive temperature range, and these data were combined with the vapor pressure data to test for consistency and to compute the thermodynamic functions associated with the formation of $MgNi_2$. The enhanced precision and reliability of the values for the thermodynamic functions, which were computed from the combined data, clearly illustrate the utility of such combination. (auth)

19354 (LAMS-2640) THERMODYNAMIC PROPERTIES OF SEVEN METALS AT ZERO PRESSURE. William J. Carter (Los Alamos Scientific Lab., N. Mex.). Sept. 1961. Contract W-7405-Eng-36. 62p.

Figures are presented which summarize the data presently available in the literature on the variation of thermal expansion and specific heat with temperature for the seven metals Cu, In, Nb, Pd, Pt, Ta, and Zr in the temperature range 293 to 3000°K. The best guesses for the functions $\alpha(T)$ and $C_p(T)$ were used to prepare curves and polynomial fits of heat content and temperature as functions of volume which are needed in shock wave equation of state work. (auth)

19355 (NAA-SR-6881) OBSERVATIONS ON THE THORIUM–HYDROGEN AND COBALT–THORIUM–HYDROGEN SYSTEMS. W. L. Korst (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1962. Contract AT(11-1)-Gen-8. 20p.

Lattice parameters are reported for various compositions of the face-centered tetragonal thorium dihydride phase. A face-centered cubic thorium hydride phase was also observed. The higher thorium hydride, Th_4H_{15}, was prepared in a nearly stoichiometric proportion. The intermetallic compound CoTh was observed to absorb hydrogen to an extraordinary degree. The composition of the resulting product corresponds approximately to the formula $CoThH_{4.2}$. (auth)

19356 (NAA-SR-7132) STUDY OF THE NICKEL–ZIRCONIUM–HYDROGEN SYSTEM. I. R. Tannenbaum, W. L. Korst, J. S. Mohl, and G. G. Libowitz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1962. Contract AT(11-1)-Gen-8. 17p.

The behavior of intermetallic compounds of the nickel–zirconium system with hydrogen was studied by x-ray-diffraction techniques and by the measurement of hydrogen absorption. It was found that only NiZr and possibly $Ni_{10}Zr_7$ form new hydrides. The other intermetallic compounds in this system either do not absorb significant quantities of hydrogen, or decompose on hydriding. (auth)

19357 (NCSC-2663-1) STUDY OF PHASE RELATIONSHIPS IN THE U–C–O SYSTEM. Final Progress Report No. 1. R. F. Stoops and P. K. Maitra (North Carolina State Coll., Raleigh). Sept. 1960. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 39p. (EURAEC-74)

A survey of literature on phase relations in U–C–O systems was completed. All of the necessary equipment for specimen preparation and testing was designed and constructed or purchased. A uranium phase containing both oxygen and carbon was apparently produced. Processing conditions determined the oxygen content of this phase; but, when it had maximum oxygen content, the composition of this material was approximately $U(C_{0.7}O_{0.3})$. (auth)

19358 (NCSC-2663-3) STUDY OF PHASE RELATIONSHIPS IN THE U–C–O SYSTEM. Quarterly Progress Report No. 2, January–March 1961. R. F. Stoops and J. V. Hamme (North Carolina State Coll., Raleigh). Mar. 31, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 16p. (EURAEC-73)

Experiments were conducted to determine the best raw materials and processing conditions for producing the U(C,O) phase. Specimens which were prepared from six different combinations of U, UC, UO_2, U_3O_8, and C were reacted at 1800°C for two hours in vacuum and in argon and carbon monoxide atmospheres and quenched in low vapor pressure oil. Another set of specimens was prepared in the same way except that they were not quenched but were furnace cooled. Quenching had little or no effect on the composition of the reaction products. Reaction in vacuum tended to produce metallic uranium and reaction in carbon monoxide produced uranium dicarbide (UC_2). Since quenching of specimens is not necessary and the best results were obtained by using an argon atmosphere, a new sintering furnace was designed and constructed to be used in addition to the vacuum quenching furnace. This greatly increased the rate at which specimens can be processed because several specimens can be reacted simultaneously in the new furnace. Evaluation of raw materials, reaction temperature, and repeated reaction cycles is in progress. (auth)

19359 (NCSC-2663-4) STUDY OF PHASE RELATIONSHIPS IN THE U–C–O SYSTEM. Quarterly Progress Report No. 3, April–June, 1961. R. F. Stoops and J. V. Hamme (North Carolina State Coll., Raleigh). June 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 17p. (EURAEC-127)

A material was produced containing about 80% of a phase having the NaCl face centered cubic crystal structure and a composition corresponding approximately to $U(C_{0.6},O_{0.4})$. Reaction in an atomosphere consisting of a mixture of controlled amounts of carbon dioxide and argon produced the best results to date. There are still insufficient data for choosing a single combination of raw materials as best. Increased reaction times up to four hours produced better results. A reaction temperature of 1800°C is more favorable for producing the U(C,O) phase than 1500°C, since UC_2 tends to form at the lower temperature instead of U(C,O). (auth)

19360 (NCSC-2663-5) STUDY OF PHASE RELATIONSHIPS IN THE U–C–O SYSTEM. Final Report No. 2. Robert F. Stoops and John V. Hamme (North Carolina State Coll., Raleigh). Sept. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 27p. (EURAEC-128)

Research was carried out to determine whether U(C,O) is a stable phase. It was previously shown that oxygen can

replace carbon in UC until the lattice parameter reaches about 4.950 Å and that this material is stable in air at room temperature for periods of time up to one year. This phase was produced from seven different combinations of raw materials, and control of atmosphere was found to be the most critical factor in producing it. Precise control of oxygen, carbon dioxide, and/or carbon monoxide partial pressures are impossible in the presence of carbon furnace components; therefore, a carbon-free furnace was designed for future work. In this investigation all U(C,O) phases with lattice parameters substantially less than 4.950 Å are thought to contain appreciable percentages of nitrogen. UO probably is not a stable phase below 1600°C, and the phases reported as UO in the literature are likely U(N,O) or U(C,N,O). (auth)

19361 (NCSC-2663-6) STUDY OF PHASE RELATIONSHIPS IN THE U–C–O SYSTEM. Progress Report, December 1961. Robert F. Stoops and John V. Hamme (North Carolina State Coll., Raleigh). Work performed under United States–Euratom Joint Research and Development Program. Contract AT(40-1)-2663. 16p. (EURAEC-235)

The effects of firing atmosphere and temperature on the yield of U(C,O) phase were investigated. Firing temperatures between 1000 and 2000°C were used as well as the following atmospheres: argon, carbon monoxide, mixtures of argon and carbon monoxide and argon and carbon dioxide, and vacuum. X-ray diffraction techniques were used to determine the phases present, the relative amounts of each phase, and the lattice parameters of the face centered cubic phases. When carbon monoxide or a partial pressure of either carbon dioxide or carbon monoxide with argon was used at temperatures between 1000 and 2000°C, reactions with uranium chips and uranium carbide occurred yielding UO_2, UC_2, and UC or U(C,O). With these atmospheres no reaction was detected with UO_2 up to 1800°C. Therefore it is unlikely that U(C,O) free of other phases can be produced by reacting uranium or uranium carbide with carbon monoxide or carbon dioxide. However, use of very low partial pressures of carbon monoxide and/or carbon dioxide may produce the desired results. As processing techniques were improved, it became increasingly difficult to produce the "U(C,O)" phase with a lattice parameter of 4.950A which was the phase selected for further investigation. This indicated that impurities are important in the formation of this phase. (auth)

19362 (NP-11627) TUNGSTEN TO GRAPHITE BONDING. Final Summary Report. Barbara Libbert (Narmco Research and Development. Div. of Narmco Industries, Inc., San Diego, Calif.). Dec. 13, 1961. Contract DA 04-495-ORD-3028. 43p.

The reactions of various metallic carbides with W and with graphite were studied for the purpose of developing a W-to-graphite bond system for use at temperatures up to 5000°F. A bond composition and process was developed that yielded good bonds; however, the desired reproducibility was not achieved. The bond composition developed also formed an excellent coating for graphite, having good thermal shock resistance and adherence at temperatures up to at least 5000°F. (auth)

19363 (NP-11689) A FUNDAMENTAL INVESTIGATION OF THE ALLOYING BEHAVIOR OF THE RARE EARTHS AND RELATED METALS. Fifth Semi-Annual Progress Report, November 1, 1961–April 30, 1962. Albert S. Yamamoto, Charles E. Lundin, and Joseph F. Nachman (Denver. Univ. Denver Research Inst.). May 1962. Contract AF33(616)-6787. 20p.

The phase diagram of the system, praseodymium–neodymium, was constructed from thermal analysis and metallographic data. This system exhibits complete liquid solubility and solid solubility in both the low-temperature and high-temperature phases. Lattice parameter determinations of the low-temperature phase throughout the system are under way. Knudsen effusion studies have provided data to determine the activities of liquid solutions of praseodymium and neodymium. Plots of the activities versus the mole fraction in the liquid indicate essentially ideal behavior for neodymium and a slight positive deviation from ideality for praseodymium. Liquid density studies are currently being undertaken to gain a better understanding of the behavior of liquid alloys of praseodymium and neodymium. (auth)

19364 (NP-11699) THE STRUCTURE OF DIMOLYBDENUM CARBIDE BY NEUTRON DIFFRACTION TECHNIQUE. Erwin Parthé (Pennsylvania. Univ., Philadelphia) and Varadachari Sadagopan (Massachusetts Inst. of Tech., Cambridge). [1962]. Contract AF49(638)-1027. 11p.

A neutron diffraction study showed that Mo_2C crystallizes with an orthorhombic unit cell with a = 4.72, b = 6.00, and c = 5.19 Å. The atomic arrangement of Mo_2C presents a new structure type. Space group is D_{2h}^{14} – Pbcn. Eight molybdenum atoms are in 8d with $x = 1/4$, $y = 1/8$, $z = 1/12$, and four carbon atoms are in 4c with $y = 3/8$. The carbon atoms in Mo_2C arrange themselves in such a way that each molybdenum atom has three nearly planar carbon neighbors. (auth)

19365 (ORO-551) DETERMINATION OF THE TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO 5000°F. Ninth Monthly Report. Frank J. Digesu and C. D. Pears (Southern Research Inst., Birmingham, Ala.). May 17, 1962. Contract AT(40-1)-2694. 6p.

The development of the system and techniques to permit determination of strains at right angle to the axis of loading in the specimen was continued. An additional optical system was developed to accept the lateral image of the gage points and project a vertical image of the same proportion to the apertures of the strain analyzer. Using a dummy specimen of steel in the load train, the automatic pressure control system for the gas-bearing universals was operated. A fluctuation of gas pressure occurred within the bearings. Multiple progressive fracture planes were observed throughout the gage length of fractured graphite and tungsten. (M.C.G.)

19366 (TID-15228) FUNDAMENTAL STUDIES IN HIGH TEMPERATURE MATERIALS PHENOMENA. Progress Report for the Period June 1, 1960 to March 1, 1962, and A Proposal for Renewal of Contract. SCOPE I: HIGH TEMPERATURE-PRESSURE PHYSICAL PROPERTY MEASUREMENTS. M. E. Bell, W. R. Buessem, Rustum Roy, V. Vand, and C. Crow. SCOPE II: ELECTRICAL RESISTIVITY MEASUREMENTS OF MATERIALS IN RELATION TO HIGH-TEMPERATURE TRANSFORMATIONS. G. W. Brindley (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). Mar. 6, 1962. Contract AT(30-1)-2581. 42p.

Progress is reported on sensitivity assessment concerning the non-contact method for measuring loss factor in dielectric materials, modification of the Schering bridge and the Tower bridge, and measurements of photoconductivity and photoresistivity. Research results are included which were obtained in tests concerned with dielectric losses in glass under pressure, properties of defective oxides, spectroscopic studies, properties of lead oxides, dielectric losses in defective ionic crystals, thermal con-

ductivity, and resistivity changes in solid state reactions. (J.R.D.)

19367 (TID-15636) THERMAL FATIGUE PROGRAM FOR INCONEL X. Interim Report. J. Howard Read (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 19, 1957. Contract [W-31-109-Eng-52]. 12p.

The results obtained in an investigation of the cyclic thermal fatigue strength of Inconel X are reported. In the test apparatus, a cyclic temperature was imposed on a thin tubular test specimen subjected to complete longitudinal constraint. This cyclic strain is the independent variable. Strain-cycles to failure and stress-cycles to failure are reported. A proposed mechanism for fatigue dependent on total plastic strain absorbed by the specimen is described. (auth)

19368 (TID-15643) AN INTERNAL FRICTION STUDY OF VERY LOW CARBON MARTENSITE (thesis). Jared K. Jackson (Purdue Univ., Lafayette, Ind.). June 1961. 134p.

The structure of martensite in iron–nickel–carbon alloys containing less than 0.015 wt % carbon was investigated by measuring the 40°C carbon diffusion internal friction peak. Measurements of the internal friction in alloys containing 0.0, 2.5, 5.1, 6.5, 10.5, and 16.5 wt % nickel were made at low frequencies with a torsion pendulum. By evaluation of the effects of varying nickel content and heat treatment on the nature of this peak, the existence of a structure in which the carbon atoms are ordered was revealed in specimens which had been quenched from temperatures at which austenite is stable. It is proposed that this structure is tetragonal martensite and that the tetragonality of the structure persists at these very low carbon contents because of the ordering influence of the residual accommodation stresses exerted on the martensite by the austenite matrix. Resolution of these stresses on the basis of the most successful of the proposed crystallographic mechanisms of martensite transformation showed that stress conditions favoring ordering can exist whether the martensite forms as plates or needles. It was found that the tetragonality of the structure disappeared on high temperature tempering and that a tetragonal structure could not be produced in binary iron–carbon alloys at this low carbon level. The amount of tetragonal phase which could be produced by quenching iron–nickel–carbon alloys increased with increasing nickel content and with increasing quenching rate. In iron–nickel–carbon alloys with a ferritic structure, the addition of nickel decreased the height and area of the 40°C peak, shifted its position to a lower temperature, but caused the peak to be only slightly broadened, if at all. The decrease in peak height with increasing nickel content was approximately linear and the amount of decrease was about 8% of the peak height in the binary iron–carbon alloy per wt % nickel. The observed peak positions at a measuring frequency of one cycle per second are 38.5°C for 0% nickel, 37.5°C for 2.5 wt % nickel, and 35.8°C for 5.1 wt % nickel. The shift in the peak position with increasing nickel content indicated that there is a long range effect of nickel on the movement of the carbon atoms within the lattice, and the change in the diffusion coefficient for carbon alloy ferrite with increasing nickel content was estimated from the magnitude of the shift. The reduction in peak area with increasing nickel content implied that short range interactions with the nickel atoms prevent some of the carbon atoms from participating in the relaxation processes which give rise to the peak under investigation. The peak broadening was analyzed by considering that the measured internal friction peak is a convolution of the theoretical peak for a single relaxation time density function. This density function, and its integral, the relaxation time distribution function, were determined by graphical trial and error solution for a quenched and tempered 5.1 wt % nickel alloy specimen. The density function was unimodal within experimental error. (auth)

19369 (TID-15660) TEMPERATURE AND PRESSURE DEPENDENCE OF CREEP IN POTASSIUM (thesis). Charles Robert Kohler (Cornell Univ., Ithaca, N. Y.). Sept. 1961. Contract [AT(30-1)-2504]. 40p.

Creep was investigated in potassium and the activation energies and activation volumes for creep were obtained. The cycling technique was employed. The activation energy was determined by observing the relative strain rate observed in a specimen creeping under constant tensile stress (σ) at one time and one temperature (T_1) and then immediately after at a different temperature (T_2). By a similar technique of cycling the hydrostatic pressure, the activation volume in creep (V_c) was also calculated. Equations are given for the calculations. Activation energy and activation volume were also investigated as a function of the tensile stress (σ), temperature (T), and strain rate ($\dot{\epsilon}$) in order to determine their influence on the activation energy and activation volume in creep. The values were then compared with values estimated for self-diffusion in potassium. (P.C.H.)

19370 (TIM-65) THE PROPERTIES OF LIQUID METALS MELTING BELOW 1000°F. H. C. Hopkins ([Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.]). Oct. 5, 1954. Contract [AT(11-1)-229]. 27p.

Graphs are presented of the following properties of liquid metals melting below 1000°F: vapor pressure, density, heat capacity, viscosity, thermal conductivity, and electric resistivity. (M.C.G.)

19371 (TIM-410) THE THERMAL EXPANSION OF ELEVEN TUNGSTEN CARBIDE CERMETS, KENNAMETALS, K-3H, K-8, K-10, K-11, K-21, K-90, K-91, K-92, K-94, K-95, AND K-96. L. C. Harrington (Pratt and Whitney Aircraft Div., United Aircraft Corp., [Hartford, Conn.]). May 20, 1957. Contract [AT(11-1)-229]. 24p.

The total thermal expansion, the mean coefficient of expansion from 68 to 1700°F, and the instantaneous coefficient are given for eleven tungsten carbide cermets. Titanium appeared to increase the thermal expansion of the cermets. The expansion also increased with increasing amounts of cobalt and decreasing amounts of tungsten carbide. (auth)

19372 (TRG-Report-267) SUMMARISED COMPATIBILITY REVIEW OF REACTOR MATERIALS FOR CO_2-COOLED GRAPHITE-MODERATED REACTORS. A. Thurlbeck (United Kingdom Atomic Energy Authority. Reactor Group, Windscale, Cumb., England). Mar. 15, 1962. 11p.

Information is presented on the compatibility of materials used in CO_2-cooled graphite-moderated reactors. The information is presented in groups based on the compatibility of specific reactor materials with CO_2, Be, Magnox, U, and between pairs of other reactor materials. (J.R.D.)

19373 (UCRL-6872-T) THE DIFFUSION OF GOLD INTO PURE ALPHA IRON. R. J. Borg and David Y. F. Lai (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 28, 1962. Contract W-7405-Eng-48. 9p.

The diffusion of Au in α-Fe was measured using Au^{198} as the tracer. The results for the paramagnetic region are summarized by the following equation: $D = 31 \exp[-62.4 \times 10^3/RT]$. The magnetic effect was observed. It was similar in magnitude and appearance to the results previously reported for the diffusion of Fe in α-Fe. (auth)

19374 (USBM-U-921) METALLURGICAL PROGRESS REPORT NUMBER 14 FOR THE PERIOD OF JANUARY 1, 1962 TO MARCH 31, 1962. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 31p.

Heat treatment and metallography were utilized to establish the eutectic composition, the vanadium solvus, the alpha, alpha plus beta, and beta-hafnium areas of the hafnium-vanadium alloy system. It appeared that both hafnium and vanadium are insoluble in the stoichiometric alloy HfV_2 (63.3% V). A study of the hafnium-iridium system was started. Alloys containing from 5 to 90% iridium were prepared. Studies are continuing on alloy systems of erbium and samarium combined with Ca, V, Cr, Zr, Fe, Ni, Cu, Al, and Si. The investigation of the chromium–gadolinium and the nickel–gadolinium phase diagrams was completed. Joining niobium and tantalum by high-temperature diffusion and low-pressure bonding was successful and it is apparent that pressure bonding may be a means of producing high-strength joints. An examination of Hf-C systems containing up to 2.4% carbon is continuing. Homogeneous molybdenum metal-gadolinium oxide compacts were prepared by mixing in a ball-mill, compacting, and sintering in a vacuum for 8 hours at 1800°C, or in a hydrogen atmosphere at 1500°C. No apparent diffusion reaction occurred between the two constituents. The melting point of thorium was established as 1725°C. The 90 Th–10 Ho alloy melts at 1700°C; the 60–40 alloy at 1640°C. The melting point of the 50 Th–50 Nd alloy melts at 1200°C. Thorium–10 and 50% praseodymium alloys melt at 1562°C and 1215°C, respectively. The following transformation temperature variations were noted: Thorium–1365°C (base); Th 60–Ho 40, 1430°C; Th 50–Nd 50, 1160°C; Th 50–Pr 50, 1080°C. Countercurrent leaching tests were initiated to prepare pregnant solutions of potassium zirconium fluoride (K_2ZrF_6) and potassium hafnium fluoride (K_2HfF_6) for fractional crystallization and selective leaching studies. Selective leaching of K_2HfF_6 from K_2ZrF_6–K_2HfF_6 crystals shows some promise as a method of producing hafnium-enriched liquors. A limited investigation of the thermodynamics of the cold-mold did not produce additional significant data. At temperatures in the order of 2600°K to 2900°K, oxygen was removed from hafnium in the form of HfO in electron-beam melting. Aluminum, magnesium, titanium, and zirconium are evaporated as the monoxides. Density of various hafnium-carbon alloys range from 12.214 g/cm³ for the stoichiometric composition (6.36% carbon) to 9.859 g/cm³ for the 11.2 wt.% composition. Small ingots containing from 9 to 12% carbon are machinable. As-cast ingots, prepared by consumable electrode arc melting pressed bars of uranium saw cuttings and graphite powder, contained a major phase of uranium monocarbide and an intergranular uranium phase. (auth)

19375 (WADC-TR-59-510(Pt.III)) STANDARDIZATION OF THERMAL EMITTANCE MEASUREMENTS. PART III. NORMAL SPECTRAL EMITTANCE, 800°–1400°K. William N. Harrison, Joseph C. Richmond, and Harold K. Skramstad (National Bureau of Standards, Washington, D. C.). Sept. 1961. Contract AF33(616)-61-02. 39p.

The equipment for direct measurement of normal spectral emittance was extensively modified by incorporation of a new external optical system that increased the amount of radiant energy available for measurement by a factor of about 10, and other associated changes. The test procedure was modified by incorporation of a "zero line" correction. The equipment was calibrated by means of sector-disk attenuators which passed known fractions of the radiant flux from a blackbody furnace. Working standards of normal spectral emittance were prepared, calibrated, and shipped. An equation relating the normal spectral emissivity of a metal to five other parameters of the metal, each of which makes a non-linear contribution to the emissivity, was solved for one set of data by "long hand" methods. Some progress was made in setting up a program for solution of the equation by use of an electronic computer. Equipment for the automatic recording of spectral emittance data in a form suitable for direct entry into an electronic computer, and on-line computation from spectral emittance data of total emittance or solar absorptance, was designed. Specifications for the equipment were prepared and bids received preparatory to placing an order for its procurement. (auth)

19376 (WADD-TR-61-72(Vol.III)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME III. DECORATION OF DISLOCATIONS AND LOW ANGLE GRAIN BOUNDARIES IN GRAPHITE SINGLE CRYSTALS. Roger Bacon and Richard Sprague (National Carbon Co. Research Lab., Parma, Ohio). May 1961. Contract AF33(616)-6915. 28p.

Dislocations and low angle grain boundaries in single crystal graphite were decorated by introducing into the crystal Cs, Br, and $FeCl_3$, which are known to form lamellar compounds with graphite. The existence of pockets or internal cracks, initiated at and bounded by tilt boundaries, was inferred. Circular pockets of trapped gas bubbles are believed to nucleate at sites of condensed vacancy disks. (auth)

19377 (AEC-tr-4879) STRUCTURE AND PROPERTIES OF LIQUID METALS. (Stroenie i Svoĭstva Zhidkikh Metallov). A. M. Samarin, ed. (Akademiya Nauk S.S.S.R. Metallurgicheskoi Institut im. A. A. Baikova). Translated by Lydia Venters (Argonne National Lab., Ill.). 1960. 211p.

A compilation of reports on the structure and properties of liquid metals is presented. (M.C.G.)

19378 (AEC-tr-5059) DETERMINATION OF THE COMPOSITION OF $M_{23}C_6$ TYPE CARBIDES IN VARIOUS AUSTENITIC ALLOYS. Jean Philibert, Guy Henry, Michel Robert, and Jean Plateau. Translated from Compt. rend., 252: 1320-2(1961). 7p.

A Castaing microprobe was used to determine the chemical composition of $M_{23}C_6$ type carbides, which are precipitated during tempering in austenitic type steels of nickel and chromium. The evolution composition of the carbide was examined as a function of the tempering time at 750°C, and a relation between its composition and that of the alloy, for a 24-hr tempering at 750°C, was established. Only the Cr/Fe and Fe/Ni concentration ratios were measured. The nickel content was constantly slight (3 or 4%) and appeared to decrease a little when the tempering duration increased. On the other hand, for increases in tempering times, the carbides became enriched in chromium (from 51 to 73%) and impoverished in iron (from 45 to 24%). A similarity of analyses obtained for samples subjected to a prolonged tempering duration at 750 to 900°C indicated that the composition of the carbides at equilibrium did not fluctuate much with the tempering temperature. (P.C.H.)

19379 (AEC-tr-5113) PRESENT KNOWLEDGE OF THE α–β ALLOTROPIC TRANSFORMATION IN URANIUM. M. Englander. Translated by M. S. Feldman (Savannah River Lab., Aiken, S. C.) from Met. ital., 51: 497-504 (1959). 10p.

Also issued in the original as reprint CEA-1508.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11653.

19380 (EURAEC-201) EXAMINATION OF ALLOYS OF ZIRCONIUM WITH NIOBIUM AND/OR SILICON WITH A VIEW TO THEIR USE AS A CLADDING MATERIAL IN WATER-COOLED NUCLEAR REACTORS. Technical Report to Part 2: LENGTH VARIATIONS IN ZIRCONIUM ALLOYS CAUSED BY THERMAL CYCLING. Quarterly Report No. 6, July–September 1961 [on] Zr ALLOYS CONTAINING Nb OR Si IN VIEW OF THEIR UTILIZATION IN WATER-COOLED REACTORS. H. Richter, P. Wincierz, and U. Zwicker (Metallgesellschaft A. G., Frankfurt am Main). Oct. 10, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 009-60-4RDA. 28p. A translation.

Tests were carried out on ZrNb3Sn1 and Zircaloy-2 seamless tube sections to determine whether thermal cycling between 20 and 350°C can bring about permanent changes in length. A slight increase in the length of the tubes was observed in tube sections annealed at temperatures between 575 and 1000°C. In cold-drawn tubes the thermal cycling result in the case of both alloys was contraction of 0.05 to 1% at cold-drawing degrees of 20 to 27% irrespective of the annealing temperature. The contraction was caused by recovery processes, and was achieved chiefly after one heating. In the case of other textures, texture-conditioned length variations can, however, occur which are not dependent on the number of the preceding thermal cycles. ZrNb2 and ZrNb3Sn1 samples were also prepared for control tests. (auth)

19381 (UCRL-Trans-824) THE STABILITY OF STACKING FAULT TETRAHEDRA IN QUENCHED CUBIC SURFACE-CENTERED METALS AND ALLOYS. C. Czjzek, A. Seeger, and S. Mader (Max-Planck-Institut für Metallforschung, Stuttgart and Stuttgart. Technische Hochschule). Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley). [1961?]. 16p.

The energy and stability of stacking fault tetrahedra in relation to triangular stacking faults bounded by extended dislocations were investigated. Four different regions of stability were distinguished as a function of defect size and stacking fault energy. For a given stacking fault energy there was found to be a maximum size for the tetrahedra. Numerical values for the stacking fault energy were derived from the observed size distributions of tetrahedra in quenched Au and NiCo. These values were in general agreement with the results of other methods for the determination of stacking fault energies. The experimental results indicated that nearly perfect tetrahedra are capable of growing in size by the absorption of further vacancies. (auth)

19382 TENSILE PROPERTIES OF COMMERCIALLY PURE NIOBIUM AT LOW TEMPERATURES. Joaquín Hernáez and José M. Sistiaga. Anales real soc. españ. fís. y quím. (Madrid), Ser. A, 57: 281-8(Nov.-Dec. 1961). (In Spanish)

The tensile properties of commercially pure niobium were studied by means of an autographical tensile machine of great accuracy and sensitivity. Experiments were made at +20, –78, and –190°C, using specimens of several grain sizes with their surfaces either untreated, oxidized, or anodized. The ductile-to-brittle transition was not observed in the untreated specimens. The oxidized specimens proved to be brittle at liquid air temperatures, while the anodized specimens are ductile. (auth)

19383 THE APPEARANCE OF DIFFERENT ORDERED STATES IN REFRACTORY NON-STOICHIOMETRIC PHASES. Robert Collongues, Jean Lefèvre, Monique Perez Y Jorba, and Francine Queyroux (Centre National de la Recherche Scientifique, [Paris]). Bull. soc. chim. France, No. 1, 149-55(Jan. 1962). (In French)

Systems of refractory oxides often have extended non-stoichiometric phases. During conventional thermal treatment, the arrangement of point faults (substitutions or holes) can be modified and new structures appear. In the ZrO_2–GeO_2 system, two intermediate phases with very similar structures appear, one being derived from Zr_3GeO_7 and the other from $ZrGeO_4$. These two phases can be considered as superstructures of the type A_3B and AB of the same disordered solution extending from ZrO_2 to $ZrGeO_4$. In ZrO_2–rare earth oxide systems, a very extended disorder lacunose solid solution appears at high temperature. For the usual compositions, variable according to the ionic radius of the rare earth compound, the distributions of cations and of holes can be ordered and different superstructures can appear. The most important corresponds to the formation of a superstructure of the pyrochlore type with the general formula $Zr_2M_2O_7$. Its principal properties are described and the extent of its region of homogeneity is interpretated on the basis of simple geometric considerations. (tr-auth)

19384 PRESSURE VESSEL DESIGN IN SWEDEN. E. Jonnerby. Chem. & Process Eng., 42: 479-81(Nov. 1961).

The yield strengths of austenitic stainless and molybdenum-boron steels are determined in order to assess the use of these materials for pressure vessel construction. Safety factors, design calculations, and working pressures of reactor vessels using these materials are analyzed. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19385 THE MECHANICAL ANISOTROPY OF SHEETS OF ZIRCONIUM. Henri Demars and Pierre Lehr. Compt. rend., 254: 1630-2(Feb. 26, 1962). (In French)

The mechanical anisotropy of annealed zirconium sheets was analyzed, and a very marked anisotropy was found for elongation which decreases very rapidly when one changes the rolling direction. A quantitative interpretation of the variation law observed for the elastic limit is given. It is based on the following hypotheses; the traction deformation occurs only by slip; it is assumed that all the crystals possessed the ideal orientation of the recrystallization texture; and it is assumed that the Schmid law is valid. (J.S.R.)

19386 ELECTRON MICROSCOPIC STUDY OF THE ANNEAL EVOLUTION OF COLD-WORKED STRUCTURES OF THE TWO ALLOYS Al–Mg AND Al–Zn. Claude Rzepski and Jean Montuelle (Centre National de la Recherche Scientifique, [Paris]). Compt. rend., 254: 1633-4(Feb. 26, 1962). (In French)

Strongly cold-worked aluminum is characterized by block structure. It is shown that the introduction of zinc decreases the tendency toward the formation of this structure and that of magnesium suppresses it almost completely. During anneal, blocks appear, then they give birth to recrystallization grains by coalescence of neighboring blocks. (tr-auth)

19387 ACTIVATION ENERGIES FOR THE CREEP OF POLYCRYSTALLINE URANIUM. Jean-Pierre André and Paul Lacombe (École des Mines, Paris). Compt. rend., 254: 2159-61(Mar. 19, 1962). (In French)

The activation energies of the creep of polycrystalline uranium were determined by studying the variation of the velocity of deformation with temperature. The constant value obtained above 580°C suggests that uranium creep in this temperature region is controlled by a displacement

mechanism for dislocation whose heat of activation is that of the self-diffusion. (tr-auth)

19388 THE IRON–ZIRCONIUM PHASE DIAGRAM. V. N. Svechnikov and A. Ts. Spektor (Inst. of Metallophysics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 143: 613-5(Mar. 21, 1962). (In Russian)

The phase diagram of the Fe–Zr system is given in more detail for the section containing 16 to 52% Zr than for the section containing 52 to 100% Zr. It was found that alloys containing 20 to 40% Zr undergo a peritectic transformation at 1480°C. Microstructural, x-ray, and differential thermal analyses show that two intermediate phases are formed. One phase contains $ZrFe_2$ (which melts congruently at 1675°C) and has a region of homogeneity at 40 to 48% Zr (ϵ-phase). The second intermediate phase has a region of homogeneity at 30 to 34% Zr and melts at 1480°C with decomposition by a peritectic reaction: $\eta \rightarrow liq_{39} + \epsilon$. The ϵ and η phases have about the same hardness. The ϵ-phase has a cubic lattice of the $MgCu_2$ type. The η-phase has a more complex lattice. The phase diagram for a content of Zr of >50% was deduced from the thermal analysis of 5 alloys. The existence of other intermetallic compounds in this region is not excluded. (TTT)

19389 THE SURFACE TENSION OF CESIUM AS A FUNCTION OF TEMPERATURE. O. A. Timofeevicheva, V. B. Lazarev, and A. V. Pershikov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 143: 618-20(Mar. 21, 1962). (In Russian)

The surface tension of cesium was determined by measuring the maximum pressure in a bubble of argon at the tip of a capillary submerged in liquid cesium. All-glass, sealed equipment had to be used because of the chemical reactivity and high vapor pressure of cesium. In a temperature region of 62 to 280°C, the surface tension σ is a linear function of temperature and can be expressed as follows: $\sigma = 68.4 - 0.046\,(t-28)$. A comparison of the Cs data with the data for Li, Na, and Rb shows that the surface tension of the alkali metals decreases with increasing atomic number. Although the theoretical values agree fairly well with the experimental values, the results show that the theory of the surface tension of metals can be improved. (TTT)

19390 THE REACTION BETWEEN THE INTERMETALLIC COMPOUNDS Ni_3Al AND Ni_3Nb. R. S. Mints, G. F. Belyaeva, and Yu. S. Malkov (Baikov Inst. of Metallurgy, USSR). Doklady Akad. Nauk S.S.S.R., 143: 871-4 (Apr. 1, 1962). (In Russian)

Alloys were prepared in an arc furnace having a nonconsumable tungsten electrode. The reaction between Ni_3Al and Ni_3Nb was followed by thermal and x-ray analyses, and by following the changes in hardness and electrical resistance as a function of composition. Microstructural analysis shows that the 10 to 40% Ni_3Nb alloys are homogeneous solid solutions similar to pure Ni_3Al. A eutectic forms at 70% Ni_3Nb. Confirmatory x-ray analyses showed only one phase with a Ni_3Al lattice at 0 to 40% Ni_3Nb, and two phases (Ni_3Al and Ni_3Nb) for higher contents of Ni_3Nb. The maximum hardness and electrical resistance occur at 40 to 50% Ni_3Nb. The minimum values are observed for the pure intermetallic compounds Ni_3Al and Ni_3Nb. (TTT)

19391 RECENT DESIGN DATA ON BERYLLIUM. Eng. Materials and Design, 5: 28-9(Jan. 1962).

Effects of forging, machining, extruding, and rolling on the tensile strength, elasticity, ductility, and strength-to-weight ratio are analyzed. Influence of metal purity and heat treatment on ductility is shown. Brazing of Be to itself or other metals using Ag, AgLi, and Be-20% Ag alloys is described. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19392 THE SURFACE TENSION OF METALLIC CESIUM. O. A. Timofeevicheva and V. B. Lazarev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel Khim. Nauk, No. 2, 358-9(Feb. 1962). (In Russian)

The surface tension of cesium σ was obtained by determining the maximum pressure in a gas bubble with the liquid cesium in equilibrium with the gas phase at the end of a capillary. It was necessary to work in sealed, all-glass equipment in an argon atmosphere because of the chemical reactivity of cesium metal. The surface tension of liquid cesium metal was calculated from the relation: $\sigma = \frac{1}{2}\,(rHg\rho) - \frac{1}{3}\,(r^2g\rho) - \frac{1}{12}\,(r^3g\rho/H)$. Here r is the radius of the capillary, g is the acceleration due to gravity and H is the difference in levels of the liquid cesium metal. Values of ρ, the density of cesium at the temperature of the measurement, were taken from the literature. It was found that the surface tension of liquid metallic cesium in dynes/cm was 67.5 at 62°C, 62.9 at 146°C, and 62.4 at 152°C. (TTT)

19393 THERMAL CONDUCTIVITY OF REFRACTORY MATERIALS. C. T. Ewing, B. E. Walker, Jr., J. R. Spann, E. W. Steinkuller, and R. R. Miller (Naval Research Lab., Washington, D. C.). J. Chem. Eng. Data, 7: 251-6(Apr. 1962).

A semitheoretical treatment of heat transfer in polycrystalline dielectric ceramics is presented in order to predict the thermal properties of the refractories. Thermal conductivity-temperature curves were determined for 23 high-temperature materials: beryllia, six beryllia–beryllium cermets, a beryllia–beryllium–molybdenum cermet, silicon carbide, three silicon carbide–graphite mixtures, boron nitride, a boron nitride–graphite mixture, four grades of beryllium, and the beryllides of molybdenum, zirconium, titanium, and niobium. Except for beryllium, measurements were made up to 950 or 1000°C. Measurements were made by an absolute method requiring a precise measurement of heat input and a comparative method using a material of known conductivity to measure the heat flow. (N.W.R.)

19394 THE ALLOY SYSTEMS OF THE GROUP Va METALS WITH YTTRIUM. Charles E. Lundin, Jr. and Donald T. Klodt (Univ. of Denver). J. Inst. Metals, 90: 341-7(May 1962).

The binary alloys systems yttrium–vanadium, yttrium–niobium, and yttrium–tantalum were investigated by microscopic examination of as-cast and isothermally annealed alloys and by incipient-melting studies of alloys. Equilibrium diagrams for the three systems were constructed. Immiscible-liquid regions are a common feature of all three systems. The yttrium–vanadium system has a single eutectic reaction at 7 ± 0.5 wt % vanadium and 1455 ± 10°C, and a region of liquid immiscibility extends from 9 ± 0.5 wt % to >99.9% vanadium. A eutectic reaction occurs in the yttrium–niobium system at 6 ± 0.5 wt % niobium and 1470 ± 10°C. The liquid immiscibility gap extends from 45 ± 0.5 to 99.5 wt % niobium. Complete immiscibility in the liquid and solid states exists in the yttrium–tantalum alloy system. (auth)

19395 THE MAXIMUM SOLID SOLUBILITY OF ZIRCONIUM IN MAGNESIUM. E. F. Emley (Magnesium Elektron, Ltd., Manchester, Eng.) and P. Duncumb. J. Inst. Metals, 90: 360-1(May 1962).

The zirconium content in zirconium rich cores immediately adjacent to the central zirconium rich particle was

used to approximate the maximum solid solubility of zirconium in magnesium. The zirconium content was also determined by point analyses with the cores themselves. An optimum voltage of 14 kv gave the most accurate result of 3.84 ± 0.13%, which is the solid solubility at the peritectic. (P.C.H.)

19396 DESIGN PROPERTIES OF REFRACTORY METALS. Jack Chelius. Machine Design, 34: 122-7 (Mar. 1, 1962).

Evaluations and comparisons are made of physical, mechanical, thermal, and electrical properties of Mo, Ta, W, and Nb. Applications, available forms and sizes, fabricability, high temperature properties, and corrosion resistance of each metal are summarized. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19397 IMPORTANT MATERIALS SYMPOSIUMS. 2. AEROSPACE MATERIALS: WHERE WE STAND TODAY. Robert J. Fabian. Materials in Design Eng., 54: 94-7 (Dec. 1961).

The highlights of seven papers presented at the Materials Symposium held at the Air Force's Aeronautical Systems Division, Phoenix, Arizona, September, 1961, are summarized. The summaries contain information on uses and properties of borides, beryllides, carbides, nitrides, silicides, and refractory oxides; effects of radiation and high temperature on soft magnetic materials; properties of inorganic and organic coatings in controlling the temperature of space vehicles; mechanical properties and welding of molybdenum, niobium, tantalum, and tungsten alloys; development of ablation materials; and fabrication of expandable structures. (N.W.R.)

19398 COLUMBIUM, A BRIGHT FUTURE, BUT HOW SOON? Donald Peckner. Materials in Design Eng., 54: 107-16(Dec. 1961).

The status and future of niobium metal and alloys are discussed by comparison with molybdenum, tantalum, and tungsten. Particular emphasis is placed on the application, fabrication, properties, and weldability of the alloys. (N.W.R.)

19399 A RAPID METHOD FOR POLISHING PYROLYTIC GRAPHITE. William C. Coons (Lockheed Aircraft Corp., Sunnyvale, Calif.). Metal Progr., 81: No. 6, 83-5 (June 1962).

An automatic polisher and techniques for producing scratch-free polished surfaces on pyrolytic graphite specimens in about 15 min after mounting are described. The polisher consists of a two-part polishing well and a stationary cross frame holding bearings. The frame is positioned so that the weighted mounted specimens are polished by simultaneous rotation against the bearings and wall. The technique consists of sectioning with a diamond-impregnated wheel; mounting in Lucite with pressure about half that normally employed; grinding with 240 and 320-grit silicon carbide paper and then 0, 3/0, and 4/0 metallographic papers; hand polishing with 1-micron diamond paste; and finally polishing with the automatic polisher on C-RO abrasive-charged Microcloth. During the final polishing, a 5% aqueous solution of chromium trioxide is applied to the abrasive as an oxidizing agent for the graphite. (N.W.R.)

19400 THE STRUCTURE OF THE ANODIC PROTECTIVE COVERING ON ALUMINUM SURFACES. H. Ginsberg and K. Wefers (Vereinigte Aluminium-Werke AG, Bonn). Metall, 16: 173-5(Mar. 1962). (In German)

The structure of the layer which is formed on the surface of aluminum after anodic oxidation in suitable electrolytes was investigated by x-ray and differential thermal analysis and with an electron microscope. These studies suggest that the same growth processes which are observed in the growth of needle-shaped and fibrous crystals occur in the formation of the protective coating. The fibrous structure indicates the presence of open diffusion paths. (J.S.R.)

19401 AGING PHENOMENA IN QUENCHED ALUMINUM ALLOYS. G. Borelius (Tekniska Hogskola, Stockholm). Metall, 16: 176-80(Mar. 1962). (In German)

Preliminary results on the study of aging phenomena in quenched Al are reported. Resistance measurements and isothermal calorimetry were the techniques used in this study. Both the resistance and the energy content varied in steps. Examples of the results obtained with pure Al are shown graphically. The pattern of the resistance decrease was the same in the Al alloys as in pure Al. (J.S.R.)

19402 EFFECT OF LOW BERYLLIUM CONCENTRATIONS ON THE RECRYSTALLIZATION OF THE PUREST ALUMINUM (RAFFINAL). H. Hug and H. Bichsel (Aluminium-Industrie A. G., Neuhausen/Rheinfall, Switzerland). Metall, 16: 193-8(Mar. 1962). (In German)

The addition of small quantities of Be to Al causes a significant reduction of the recrystallization temperatures. Since foreign atoms generally lead to an increased recrystallization temperature, the effect of the Be can be explained as a precipitation of the dissolved Fe by compound formation. This was confirmed by diffusion studies in which the existence of a reaction product between Be and Fe was detected. Electron microscopic diagrams obtained from vapor-deposited foils illustrate the accelerated growth of the recrystallization nuclei in the Be-containing sheets. Be-free samples under similar conditions lead only to an improvement of the sub-grain structure. The retardation of recovery and recrystallization processes by dissolved foreign atoms (iron) can be traced back to the blocking of lattice faults. (tr-auth)

19403 THE NICKEL END OF THE TERNARY SYSTEM NICKEL–ALUMINUM–BORON. H. H. Stadelmaier and A. C. Fraker (North Carolina State Coll., Raleigh). Metall, 16: 212-14(Mar. 1962). (In German)

The nickel end of the ternary system nickel–aluminum–boron was described by means of the fusion projection and of an isothermal cross section at 800°C. In addition to the known phrases in both binary boundary systems, nickel–aluminum and nickel–boron, a congruent fused ternary boride $Ni_{60}Al_2B_{21}$ occurs. Its structure is cubic ($D8_4$ type) and its lattice constant is 10.55 Å. Both the fusion surface of the ternary boride and its homogeneity range are sharply expanded. (tr-auth)

19404 THE PRESENT STATUS OF REFRACTORY METALS AND ALLOYS. E. D. Weisert. Metals Eng. Quart., 2: 3-15(Feb. 1962).

Alloying, consolidation (by powder metallurgy, vacuum arc melting, and electron beam melting), fabrication, and coating of W, Mo, Nb, Ta, Zr, Cr, Ti, and V to produce sheet, plate, tubing, and forgings for use in electronic components, gas turbine vanes and rotors, and rocket hardware are described and discussed. (Rev. Metal Lit., 19: No. 4 (Apr. 1962)

19405 INVESTIGATION OF THE URANIUM–THORIUM–CARBON SYSTEM. F. Benesovsky and E. Rudy. Monatsh. Chem., 92: 1176-83(Dec. 1962).

Metallographic and x-ray investigations of phase equilibria at 1000 and 1700°C U-C, Th-C, and U-Th-C using pressure-sintered and vacuum annealed specimens were

made. Lattice parameters and thermodynamic stability of carbide phases are described. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19406 NOTE ON THE SUPERCONDUCTIVITY OF ALLOYS. C. J. Gorter (Kamerlingh Onnes Lab., Leiden). Phys. Letters, 1: 69-70(May 1, 1962).

The filamentary or mesh-like character of the current and flux paths in the interior of certain types of superconducting alloys is discussed. The penetration of a magnetic field into this type of alloy is also discussed. (T.F.H.)

19407 URANIUM CARBIDE—POTENTIAL FAST REACTOR FUEL. L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Research (London), 15: 207-13(May 1962).

The present position of research into the manufacture, properties, and irradiation behavior of uranium monocarbide is summarized. It is concluded that the material offers a combination of characteristics suggesting useful application in fast reactors designed for high power rating. (auth)

19408 BORAL AS PROTECTIVE MATERIAL AGAINST THERMAL NEUTRONS. O. Rudiger, J. Stickforth, and G. Lohrke. Tech. Mitt. Krupp, 19: 154-72(Nov. 1962). (In German)

The technology of boral, an aluminum sheet clad with a material consisting of a suspension of B_4C in an aluminum matrix, is studied. Boral is manufactured by alloying the coating in ingot or powder form to the aluminum sheet. Data are given for physical properties, neutron absorption, mechanical properties, and microstructure. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19409 DIFFUSION OF URANIUM-233 IN URANIUM DIOXIDE. Roland Lindner and Franz Schmitz (Chalmers Tekniska Högskola, Göteborg). Z. Naturforsch., 16a: 1373-8(Dec. 1961). (In German)

The self-diffusion of uranium in UO_2 sintered bodies was determined with the help of α radiation absorption and by direct measurement of the concentration distribution of U^{233}. In a hydrogen atmosphere and in the temperature range from 1300 to 1600°C, the value $D = 0.23 \exp(-104.6$ kcal/RT) $cm^2\ sec^{-1}$ is valid. Orienting research in argon atmospheres between 900 and 1200°C gave an activation energy of only 52 kcal/mole. (tr-auth)

19410 CONCENTRATION REGIONS OF NIOBIUM SILICIDE STABILITY AT 1250°C. S. I. Alyamovskii, P. V. Gel'd, and I. I. Matveenko. Zhur. Neorg. Khim., 7: 836-43 (Apr. 1962). (In Russian)

Phase studies of Nb–Si at 1500°C indicated two stable silicides α–Nb_5Si_3 and $NbSi_2$; Nb_4Si was not observed. It was found that α–Nb_4Si_3 is a special phase with variable composition and stability ($NbSi_{0.58}$ to $NbSi_{0.66}$) at 1250°. The niobium bisilicide is a single phase ($NbSi_{1.85}$ to $NbSi_{2.20}$) developed from α–Nb_5Si_3 by replacement. (R.V.J.)

19411 EXPERIMENTAL APPROXIMATION OF MELTING TEMPERATURES FOR VARIOUS ALLOYS OF Ni–Ti–Cr–Mo–W–Nb SYSTEM. F. M. Perel'man. Zhur. Neorg. Khim., 7: 844-9(Apr. 1962). (In Russian)

Approximate fusing diagrams of Ni and Ti enriched hexacomponent Ni–Ti–Cr–Mo–W–Nb alloys were constructed on the basis of published data for binary and ternary alloys. The approximate melting temperature for 65% Ni–15% Cr–5% Mo–5% Ti–7% W–3% Nb was found at 1360°C and for 70% Ni–10% Cr–5% Mo–5% Ti–7% W–3% Nb at 1376°C, experimentally verified melting temperatures were 1356° and 1350°C, respectively. (R.V.J.)

19412 INVESTIGATION OF SOLID SOLUTION OF CHROMIUM BASE Cr–Ni–Mo ALLOYS. A. T. Grigor'ev and V. V. Kuprina. Zhur. Neorg. Khim., 7: 942-5(Apr. 1962). (In Russian)

The constitution diagrams of Cr–Ni–Mo indicated four solid solutions based on Cr β-, γ-, δ-, and ϵ-modification and three phase solutions ($\beta + \gamma$), ($\gamma + \delta$), and ($\delta + \epsilon$) at initial Cr transition points of 1350°($\beta \rightleftharpoons \gamma$), 1650°($\gamma \rightleftharpoons \delta$), and 1830°($\delta \rightleftharpoons \epsilon$). (R.V.J.)

19413 TOUGHNESS AND BRITTLENESS IN METALS. Lectures Delivered at The Institution of Metallurgists Refresher Course., 1960. London, Iliffe Books Ltd. and New York, Interscience Publishers Inc., 1961. 111p.

Four papers are included on the toughness and brittleness of metals. The differences between tough and brittle fractures and the mechanisms of crack formation are discussed. The effect of environment on embrittlement is described by discussing gaseous diffusion and hydrogen embrittlement. Other topics discussed include: strain rate, work hardening, prepared orientation, grain size, solute additions, irradiation, multi-phase alloys, heat-treatable alloys, precipitation-hardening alloys, delayed fracture, corrosion fatigue, corrosion products, effects of various coatings, and cleavage and shear fracture. The engineering aspects of stable and unstable fractures are illustrated with classical cases of fracture in ships, bridges, storage tanks, and piles. (N.W.R.)

19414 4e COLLOQUE DE MÉTALLURGIE PROPRIÉTÉS DES JOINTS DE GRAINS, ORGANISÉ À SACLAY LES 27 ET 28 JUIN 1960. (Fourth Metallurgy Symposium at Saclay. Properties of Grain Boundaries. Held at Saclay, June 27-28, 1960). Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. 184p.

The seventeen papers and the discussions following each, which were presented at the Fourth Metallurgy Symposium held at Saclay on June 27-28, 1960, are compiled. Individual abstracts were prepared for each paper. (J.S.R.)

19415 ORIENTATION-DEPENDENCE OF GRAIN BOUNDARY MOBILITY. M. N. Parthasarathi and Paul A. Beck. p.3-6 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In English)

In a recent study it was shown that it is possible to obtain a sharp recrystallization texture in a case where natural nuclei are absent, and recrystallization starts from numerous random nuclei artificially introduced by severe local deformation followed by annealing. An Al single crystal rolled to 80% reduction could be annealed for 1000 sec at 350°C without the occurrence of recrystallization. Rubbing such a rolled crystal with emery on one surface induced the formation of random recrystallization grains after a few seconds of annealing at 350°C. A second series of experiments was made in Al single crystals to test the hypothesis that the absence of rotations in the annealed structure is due to anisotropy of boundary mobility. The texture of the artificially nucleated layer was found to be quite random. After 150 min of annealing, recrystallization was complete, and the texture was found to consist of eight components, each related to the deformation texture by a (111) rotation of approximately 40°. (J.S.R.)

19416 STUDY OF THE MECHANISM OF INTERGRANULAR FRAGILITY. C. Crussard, J. Plateau, and G. Henry. p.7-21 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

The various mechanisms of intergranular fragility are

classified. Two cases are distinguished: in one the fragility, resulting from an intergranular reaction, is revealed by a low-temperature test (room temperature or below), and in the other the fragilizing reaction is produced during a hot deformation. In both cases, the fragilizing reaction consists of an accumulation of alloying elements (intergranular segregation with simple interfacial adsorption or with actual precipitation) or of reticular lacunes (pore formation). Several examples are reviewed and discussed. (tr-auth)

19417 COMPARED STABILITY OF GRAIN BOUNDARIES AND SUB-BOUNDARIES OF ZONE-MELTED IRON SUBMITTED TO THERMAL CYCLING. Simone Besnard and Jean Talbot. p.23-8 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Very pure iron was exposed to thermal cycling at 850° for 30 min and then 30 min outside the furnace so that the dislocations were mobile, and a study was made to determine if a polygonized structure was obtained. The results showed that for an iron of given purity, the grain boundaries of the recrystallized metal are more mobile than those of the polygonized metal. The boundary mobility is also very sensitive to the iron purity. The migration occurs more easily in the case where the iron is very pure. Only very slight variations of the substructure limits were observed during the cycling. The subgrain dimensions vary only slightly and in no case can their disappearance be observed. The metal purity also affects the substructure: the sub-boundaries of electrolytic iron are displaced less than those of zone-melted iron. The polygonized structure stabilizes the boundaries by opposing their displacement. The internal stresses arising in the recrystallized metal give way, when the number of cycles is sufficient, to a very sharp polygonization of the grains of zone-melted iron. Under the same experimental conditions, this phenomenon does not occur in iron of lower purity. The polygonized state of iron is insensitive to high-temperature mechanical stress. (J.S.R.)

19418 STUDY OF THE BEHAVIOR OF THE POLYGONIZATION SUB-BOUNDARIES SUBJECTED TO MECHANICAL AND THERMAL TREATMENTS. Pierre Lesbats and Jean Montuelle. p.29-35 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Previous studies have indicated that repeated cycling of Al crystals by an intergranular force can cause the elimination of a fraction of the imperfection. It is shown that polygonized structures are simplified during thermal cycling. It is thought that the internal stresses, introduced by a temperature change, permit the sub-boundary lattice (while the crystal is held at high temperature) to assume a configuration of minimum energy which is particular stable. This explains the low mobility of polygonization walls in the final states. In effect, it is shown that the polygonized structure cannot be eliminated by thermal treatments even if they are repeated a large number of times. The impurities, by slowing the movements of the dislocation walls, retard considerably the evolution of polygonized structures. (J.S.R.)

19419 EFFECT OF THE ELIMINATION OF TEMPERING-INDUCED POINT FAULTS ON THE INTERGRANULAR FRAGILITY OF ALUMINUM–ZINC ALLOYS. Pierre Gobin. p.37-46 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Al–Zn alloys with high zinc concentration possess good mechanical characteristics, but at room temperature and noncorrosive atmosphere a considerable weakening of the intergranular cohesion occurs. A mechanism clarifying the fragility phenomena observed is proposed. It is shown that the fragility is the result of complex processes. The fragility which is present long after the tempering treatment is preceded by two fragility stages. During these two stages, while the hardness remains constant, the expansion and rupture resistance passes through very low values. The role of the condensation of holes on grain boundaries is shown in the fragility mechanism. Polygonization, by increasing the rapidity of the elimination of point faults, causes the Al–Zn alloys to be much less fragile. In effect, the polygonized alloys resist the action of a static stress much better than recrystallized alloys. The tendency to intergranular decohesion is dependent on the disorientation relative to adjacent grains; it increased with the value of the disorientation angle. (J.S.R.)

19420 THE ASPECT OF PRECIPITATION IN THE VICINITY OF GRAIN BOUNDARIES IN Al–Zn–Mg ALLOYS. R. Graf and B. Genty. p.47-52 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Al–Zn–Mg alloys of various compositions were examined with an electron microscope. The samples were sliced by ion bombardment. The precipitation on the grain boundaries was always more advanced than that in the grain interior, and each grain was edged by an impoverished border. At the interior limit of the border, the precipitates are larger. These observations permit the intergranular fragility of the tempered Al–Zn–Mg alloys to be explained. (tr-auth)

19421 FACTORS IN THE MIGRATION OF GRAIN BOUNDARIES IN α URANIUM. [D.] Calais, J. Pascal, and P. Lacombe (Ecole des Mines, Paris). p.53-70 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

The most recent concepts on boundary migration are briefly reviewed to show the complexity of the problem. In the present study of factors involved in the migration of grain boundaries in α uranium, the important role played in the passage from the worked state to the recrystallized state by various crystallographic mechanisms such as twinning and the effects of impurities on the boundary migration are emphasized. The relationship between the various deformation modes of the uranium monocrystal and the boundary migration of recrystallization crystals is first analyzed. The interfacial energy of the twin boundaries and the boundary migration factor of recrystallization grains are discussed. In conclusion, the migration of grain boundaries in uranium by secondary recrystallization is considered. The results showed that some orientation relations between the deformed matrix and the crystal of recrystallization support the Beck theory of "selective growth," generalized to the case of uranium. (J.S.R.)

19422 EFFECTS OF DIFFUSION ON CORROSION OF METALS BY FUSED SALTS. C. Edeleanu, J. G. Gibson, and J. E. Meredith. p.71-4 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In English)

If an 18-8 steel is allowed to corrode in a fused 50-50

NaCl–KCl melt at 800° in the presence of air, it is found that it suffers attack which is not continuous at the boundaries and that, especially away from the surface of the specimen, voids appear which do not seem to be in contact with each other or with the outside of the specimen. After etching, a narrow region on either side of the boundary and next to the outside surface is revealed. A second series of very small voids surrounds the larger voids. It is suggested that these results may be explained by the selective removal of chromium by the corrosion reaction and that the chromium diffuses outward forming voids. (J.S.R.)

19423 EFFECT OF CHROMIUM ION ON THE INTERGRANULAR CORROSION OF AUSTENITIC STAINLESS STEELS IN NITRIC MEDIUM. H. Coriou, L. Grall, G. Kurka, and G. Plante. p.75-84 of "4° Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

The corrosion of austenitic stainless steels in 5 N nitric acid containing 1 g/l of hexavalent chromium was systematically studied. The samples of 18/10 steel (very low carbon or titanium stabilized) and 25/20 steel (very low carbon) undergo an extremely severe intergranular corrosion, but they are insensitive to the sulfocupric test (Strauss reagent) and to the nitric test (Huey reagent). The corrosion observed was present at all the orientation discontinuities: grain boundaries, twin boundaries, and cold-worked sites. It appears to depend directly on structure elements and is found independent of classic precipitation phenomena. The morphology of this type of corrosion was studied in detail, and the decohesion of the metal by grain layers was shown. These results indicate the effect of the grain dimension and the presence of Cr^{6+}. (tr-auth)

19424 SEGREGATION, EMBRITTLEMENT, AND SLIDING AT GRAIN BOUNDARIES. D. McLean (National Physical Lab., Teddington, Middx, Eng.). p.85-94 of "4° Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Electron microscope examination using replicas and thin foils has given qualitative evidence of adsorption of solutes at grain boundaries, and the first quantitative measurements were made of the amount of adsorption and the effect on interfacial energy. Adsorption at grain boundaries may have a big effect on fracture strength at both low and high temperature. There is, however, a fundamental distinction between brittle fracture at low and high temperatures arising from the fact that diffusion is possible in the latter case. The high-temperature variety also requires grain boundary sliding, which at high temperatures becomes important. Recent work confirms that the amount of sliding is linearly related to grain deformation and also depends on grain size. (auth)

19425 THE INTERACTIONS BETWEEN BOUNDARIES AND IMPURITIES. J. Friedel (Faculté des Sciences, Orsay, France). p.95-104 of "4° Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

The types of interactions possible between boundaries and impurities can be divided into the elastic interactions (which can be analyzed in terms of more or less classic mechanics), chemical reactions (which affect in greater detail the structure of the crystal), and indirect reactions (which are connected to the kinetics of the evolution of solid solutions in thermodynamic disequilibrium). These types of interactions are reviewed. (J.S.R.)

19426 EFFECT OF IMPURITIES IN THE DIFFUSION AT THE GRAIN BOUNDARIES OF IRON AND NICKEL. P. Guiraldenq and P. Lacombe (Ecole des Mines, Paris). p.105-14 of "4° Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Tracer techniques were used to study the intergranular diffusion in relation to impurities in commercial iron (99.7% pure), high-purity iron (99.99% pure), and nickel of three grades of purity. A comparison of the results obtained by the self-diffusion of γ iron and of iron tracers in the grain boundaries of nickel has shown that no definite conclusions can be drawn on the role of impurities in this diffusion. In γ iron, the impurities favor and exaggerate the intergranular self-diffusion, but in nickel the impurities decrease the diffusion. Thermodynamic properties of the grain boundaries might explain the results. (J.S.R.)

19427 SOME OBSERVATIONS RELATIVE TO INTERGRANULAR PHENOMENA IN LIGHT ALLOYS BY ELECTRON MICROGRAPHY OF THIN FILMS. A. Saulnier and M. Croutzeilles. p.115-21 of "4° Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

Some of the phenomena observed at the grain boundaries during a study of the evolution of structure after tempering in Al–Si (1.2% Si) and Al–Zn (12% Zn) alloys are reported. The results showed that the attraction force of the boundaries for holes and for addition elements is exercised at a much greater distance for the holes than for the metallic atoms. The zone denuded of precipitates in the vicinity of the boundaries does not appear to result directly from the impoverishment in holes, but is explained by simple diffusion anomalies in the boundary vicinity. The existence of this zone cannot be given as proof of the effect of holes on precipitation. The microdiffraction diagrams establish the relative orientation of the grains in contact and diffuse runners. These runners in the case of Al–Zn alloys seem to indicate that the intergranular precipitation of zinc during its entire first stage is produced by a transition lattice which assures a continuous bond between the lattice of two grains in contact. (J.S.R.)

19428 ELECTRON MICROSCOPE STUDY OF THE FORMATION OF SUB-BOUNDARIES (SUB-BOUNDARIES OF POLYGONIZED STRUCTURE) IN THE CASE OF PURE ALUMINUM. C. Messager and O. Dimitrov. p.123-6 of "4° Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

An electron microscopic study was made of thin films of Al containing 80 and 10 ppm impurities in order to determine the distribution of faults in slightly worked Al, to follow the evolution of the structure during anneal, and to observe the formation of sub-boundaries of the polygonized structure. The results showed that when the working is too weak to fragment the grains and permit recrystallization, the dislocations introduced by working are not completely eliminated by annealing. They form groups at high temperature to give birth to the polygonized state. The appearance of fault-free zones precedes the formation of sub-boundaries. The purer the aluminum, the lower the temperature at which polygonization occurs. The final configuration of the dislocations at the interior of sub-boundaries does not appear to be affected by the presence of impurities and does not seem to be varied by prolonged annealing at high temperatures. (J.S.R.)

19429 TRANSMISSION ELECTRON MICROSCOPIC STUDY OF THE STRUCTURE AND PROPERTIES OF GRAIN BOUNDARIES. A. Berghezan and A. Fourdeux (European Research Associates, Brussels). p.127-47 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

An electron microscopic study was made of the formation, structure, and properties of grain boundaries in aluminum, niobium, and zinc. The types of boundaries observed were bend boundaries, torsion boundaries, mixed boundaries, boundary seams, and twin boundaries. The boundary movement, dislocation movements in the boundary plane, boundaries acting as donor-acceptors, precipitation on boundaries, and corrosion figures on dislocation lines were among the interactions observed and discussed. It is concluded that the boundary dislocation models predicted by theory are completely proved by the results. (J.S.R.)

19430 STUDY OF THE PROPERTIES OF GRAIN BOUNDARIES OF PURE ALUMINUM, STUDIED WITH BICRYSTALS OF PREDETERMINED ORIENTATION. Claude Goux and Jean Montuelle (Centre d'Études de Chimie Métallurgique, Vitrysur-Seine, France). p.149-60 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

In order to study the properties of grain boundaries as a function of the relative orientation of the crystal, the investigations were made on bicrystalline samples of pure aluminum in which the constituent crystal had an imposed orientation. The orientation relations defining the grain boundary are reviewed in detail, and the preparation of the oriented bicrystals is described. Boundary formation during solidification and wrinkle phenomena are examined, and intergranular corrosion and diffusion are studied. The structure of boundaries with strong disorientation was determined. The results of the study showed that in aluminum with titre between 99.9 and 99.9965% the intergranular segregations vary with the free energy of the boundary. In zone-melted aluminum the residual impurities, less than 10 ppm, are concentrated on dislocations in the crystal interior. The structure of boundaries with low disorientations is explained by the theory of dislocations which considers that very rapid variation of the boundary energy as a function of the disorientation for low disorientation values. In twins of low index, in which the twinning plane has a high atomic density, the structure of the transition lattice can be interpretated by the slip of dense reticular planes with respect to their immediate neighbors. The neighboring boundaries of twin boundaries can be obtained by addition to the twin boundaries of supplementary faults, analogous to dislocations. The presence of impurities causes an enlargement of the transition lattice. (J.S.R.)

19431 "COHERENT" AND "INCOHERENT" GRAIN BOUNDARIES IN CUBIC METAL TWINS. D. Whitwham (Centre de Recherches des T.L.H., Antony, France) and P. Lacombe. p.161-82 of "4e Colloque de Métallurgie Propriétés des Joints de Grains." Saclay, France, Centre d'Études Nucléaires and Paris, Presses Universitaires de France, 1961. (In French)

The experimental conditions for the observation of twins in Al and Cu are described, and the preliminary experimental results are briefly reported as an introduction to the principle points of study. The crystallography of twins and, in particular, the origin in the cubic system of twins other than those of spinels are the first point of study. The second point is the nature of the boundary or of the contact surface between two symmetrical lattices. A "coherent" surface is one in which the twin boundary coincides with the plane of symmetry and all other surfaces are "incoherent". The consequences of the existence of these coherent or incoherent interfaces with respect to the general theory of the grain boundary are then discussed. (J.S.R.)

Radiation Effects

19432 (AD-266011) ANALYSIS OF EXPERIMENTAL RADIATION EFFECTS DATA. Report No. 1. First Quarterly Progress Report, June 1, 1961– August 31, 1961. Melville Clark, Jr. (Edgerton, Germeshausen and Grier, Inc., Boston). Sept. 27, 1961. Contract DA36-039 SC-87306. 18p. (EG&G-B-2311)

A scheme suitable for the automatic machine analysis of the I sub cbo (reverse leakage current between base and collector with open emitter) data was devised and is now being coded. A literature search revealed a method according to which the h sub Fe data (forward current transfer) data should be analyzed and a great deal of related, pertinent data concerning the radiation damage to transistors, both permanent and transient. This material is briefly summarized. The transient effects induced in cables by radiation were estimated and are believed to be negligible. The distortion of the transistor transients due to reflection of neutrons among the walls is being analyzed. (auth)

19433 (ASD-TR-61-648) COMPARISON OF GAMMA IRRADIATION FACILITIES. B. L. Cash and R. D. Longley (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Nov. 1961. Contract AF33(616)-7547. 37p.

As part of a program to reduce experimental uncertainties in radiation-effects data, a "portable" 2500-curie Co^{60} standard source was used for comparing dosimetric techniques and source intensities at 12 gamma irradiation facilities. After the radiation profile and the dose rate in the standard irradiator were determined the source, along with associated equipment and dosimetry, was transported in a trailer to each of the participating facilities. Measurements by participating facilities in the standard irradiator were compared to the calibration of the standard irradiator. Dose rates determined using this source for dosimetry facility irradiators were compared to the dose rates determined by resident dosimetry. (auth)

19434 (BAW-1247) RESULTS OF NS SAVANNAH CORE I FUEL ROD IRRADIATION PROGRAM. C. A. Burkart and W. R. DeBoskey (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Apr. 1962. Contract AT(30-3)-274. 202p.

An irradiation test program was carried out to confirm the NMSR Core I fuel rod design. This program provided data on the behavior of the UO_2 fuel and stainless steel cladding materials tested in the range of Core I operating conditions. The coolant water temperature and pressure are 508°F and 1750 psi. The average and maximum fuel rod heat fluxes are 62000 and 234,000 Btu/hr-ft^2 with a maximum burnup of 16,700 Mwd/ton of oxide. Irradiations were conducted in a high temperature and pressure dynamic water loop and in static capsules. UO_2 fuel rods clad in stainless steel performed satisfactorily during irradiation. Heat ratings, thermal conditions, and burnup conditions bracketed Core I design maximum and average condi-

tions. Satisfactory performance is based on insignificant dimensional changes, the integrity of the cladding, end caps, and welds, and fuel pellet stability, and fission gas retention characteristics. Loop irradiations were conducted in B&W's MTR test loop at a water temperature and pressure of 500°F and 1500 psi. For the seven fuel rod specimens irradiated, the average cladding surface heat flux was approximately 100,000 Btu/hr-ft^2. No harmful effects were noted. Fuel burnups ranged from 550 to 1100 Mwd/ton of oxide. The static tests were conducted in open process water and in sealed NaK capsules. Fuel rod specimens were irradiated to burnups of 350 to 16500 Mwd/ton of oxide. Cladding surface heat fluxes varied from 200,000 to 330,000 Btu/hr-ft^2. There was no evidence of cladding failure or distortion. A sublimation-condensation process caused some fuel redistribution at the higher heat ratings. Fission gas release varied from 4% at low heat rating to 10% at the higher ratings. (auth)

19435 (GA-563) IRRADIATION EFFECTS ON THE SURFACE REACTIONS OF METALS. Summary Report, January 15, 1958–October 1, 1958. M. Simnad, J. L. White, and F. D. Carpenter (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 31, 1958. Contract AT(04-3)-179. 34p.

The effects of various types of radiation on the surface properties of metals and metal oxides are under investigation by three experimental approaches: the kinetics of gas-metal reactions, electrode potentials, and the rates of dissolution processes in aqueous solutions. The procurement and assembly of apparatus, preparation and irradiation of specimens, and evaluation and development of experimental methods are discussed. The techniques were tested by comparative measurements on cold-worked and annealed metals, and preliminary results are reported. The irradiations of the first sets of specimens are near completion. Apparatus for insertion into the core of a reactor is being designed and tested for measurements of the kinetics of gas-metal reactions in radiation fields. (auth)

19436 (GAMD-657) EROSION OF GRAPHITE BY HELIUM RECOILS FROM NEUTRON SCATTERING AND BY FORMATION OF HeC. E. Creutz and Sam Cunningham (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 22, 1959. Contract [AT(04-3)-314]. 4p.

The effects of helium atoms recoiling into graphite after collisions with fast neutrons on the mass transfer of carbon atoms are discussed. Absorption of the recoil atoms by graphite, sputtering, and chemical effects between helium ions and graphite are described. Erosion due to the formation of HeC is also discussed. (M.C.G.)

19437 (HW-73072) IRRADIATION ALTERATION OF URANIUM DIOXIDE. W. E. Roake (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 53p.

Measurements of physical, chemical, and thermal properties of irradiated and nonirradiated ceramic nuclear fuel materials were correlated with phenomena observed in a large number of test assemblies irradiated in the range 0 to 30 × 10^{20} fissions per cm^3 at fuel temperatures extending to the melting point. These phenomena include production of metastable states and modifications of fuel structure that affect order of magnitude changes in thermal and electrical properties of uranium dioxide. Vaporization and condensation of nuclear fuels, studied out-of-reactor, were shown to be associated with fuel densification, relocation, columnar grain growth, and the homogenizing of heterogeneous fuel mixtures during irradiation. Segregation of fission products and plutonium was measured and correlated with vapor phase transfer and with solid state diffusional processes. Significant changes in the melting point of UO_2 were observed with specimens irradiated to a wide range of exposure. The observations demonstrate the remarkable effectiveness of extremely small concentrations of impurity (fission fragment) atoms in stabilizing the UO_2 crystal lattice. The data, integrated with an extensive study of UO_2 melting and dissociation, suggest changes in the uranium-oxygen phase diagram in the region of the melting point of UO_2. Rapid heating and cooling of microscopic fuel regions associated with individual fission events produce observed effects, at relatively low bulk fuel temperatures, that are reproduced, outside a neutron field, only at temperatures several hundreds of degrees greater. Sintering of compacted uranium dioxide powder at only 300 to 400°C bulk fuel temperatures was revealed during irradiation. (auth)

19438 (IDO-11102) IRRADIATION LOOP STUDIES OF ORGANIC REACTOR COOLANTS. Quarterly Report, July 1–September 30, 1961. E. A. Mason and W. N. Bley (Massachusetts Inst. of Tech., Cambridge). Jan. 1, 1962. Contract AT(10-1)-1067. 30p. (MITNE-9)

Irradiation of Santowax OMP was initiated in the MIT Reactor Organic In-Pile Loop on August 9, 1961. As of September 30, 1961 the total absorbed dose to an average inventory of 5000 grams of coolant was 79,900 watt-hrs. In this same period of time approximately 35% of the terphenyls in the coolant were degraded. The dose rate (determined by calorimetry) was 52.4 watt-hrs absorbed/Megawatt-hour of reactor operation for unirradiated Santowax OMP at 600°F. Thirty-three per cent of the absorbed dose is from fast neutrons and 67% from gamma photons. The G value for the mixture of ortho, meta, and para terphenyls was estimated to be −0.19 molecules of o,m,p-terphenyl/100 ev absorbed in the coolant at 30% DP (concentration of degradation products). The portion of the degradation due to fast neutrons was estimated to be G_n(-omp) = 0.375 molecules of terphenyls/100 ev absorbed. The heat transfer coefficients decreased as the concentration of degradation products (%DP) increased. Essentially all of the change in the coefficients was accounted for by the increases in the viscosity and density. Preliminary results of the ash content, carbon-hydrogen ratios, density, viscosity, and the radiolytic gas composition are presented, as a function of %DP. Plots of the measured neutron spectra from fission energy to thermal energy are presented. (auth)

19439 (REIC-23) PROTON AND ELECTRON DAMAGE TO SOLAR CELLS. L. W. Aukerman (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Apr. 1, 1962. Contract AF-33(616)-7375. 33p.

The results of experiments carried out at a number of laboratories to determine the effects of proton and electron irradiation on the performance of solar cells are summarized. Most of the studies were concerned with Si cells which utilize a p-n junction close to the surface; although, some preliminary results for GaAs solar cells also are included. The results of many laboratories are compared in a ϕ_c vs E_p plot, where ϕ_c is the integrated proton flux required to reduce the efficiency of the Si solar cell by 25% under conditions of approximately 100 mw/cm^2 artificial illumination, and E_p is the proton energy. The trend suggests that the expected proportionality between ϕ_c and E_p holds for energies up to about 200 Mev or higher. The effects of radiation damage on the spectral response are also discussed and the experiments interpreted in terms of radiation-damage theory, where possible. Some comments

concerning shielding and the relative effectiveness of different bombarding particles in creating damage are also included. (auth)

19440 (FTD-TT-62-414) THE EFFECT OF GAMMA IRRADIATION ON CERTAIN PROPERTIES OF CURRENT-CONDUCTING FILMS. O. K. Botvinkin and O. B. Vorob'eva (Vorob'yeva). Translated from Steklo i Keram., 19: No. 1, 4(1962). 3p.

Results of an investigation are presented on the effects of γ radiation on the electric conductivity of semiconductor films. It was found that γ irradiation does not change the electric properties of such films. (J.R.D.)

19441 THE EFFECTS OF GAMMA RADIATION ON ELECTRIC CHARACTERISTICS OF THE ELECTRONIC CIRCUIT COMPONENTS. [PART] I. Takashi Nakakado and Toshifumi Saigusa (Sumitomo Atomic Energy Industries, Ltd., Takarazuka, Japan). Bull. Inst. Chem. Research, Kyoto Univ., 40: 67-80(Mar. 1962). (In English)

Five kinds of electronic circuit components were irradiated by Co^{60} gamma rays with doses of $10^6 \sim 10^7$ r. The effects of the radiation on resistors, condensers, solid diodes, transistors, and magnetic cores, were measured during and after the irradiation. Some changes of properties of the elements were explained to be partially due to the production of positive or negative vacancies produced in materials used by the radiation, however, many phenomena observed seemed to be very complicated and could not endure the simple interpretation. In spite of the scatter of measured data and difficulty of the interpretation for observed phenomena by this preliminary survey on the effects of gamma rays on the electronic circuit components, it is revealed that some constants are influenced so much that the characteristics of the electronic circuit composed of these elements would change considerably when the system is used in an intense radiation field. (auth)

19442 RELATIVE CONCENTRATION OF F, M AND R CENTERS. Akizo Okuda (Kyoto Univ.) and Kosuke Asai. Bull. Inst. Chem. Research, Kyoto Univ., 40: 81-5(Mar. 1962). (In English)

Relative concentrations of the F, M, and R centers in alkali halides were investigated, over a wide range of absorption intensities, on the crystals of LiF, LiF(Pb) and LiF(Mg) which were irradiated with γ rays at room temperature. In early stages of the coloration, the M-center concentration is proportional to square of the F-center concentration and the R-center concentration to cube of the F-center concentration except for the LiF(Mg) which shows an intermediate band on the long-wavelength side of F band after the γ irradiation. Some deviation from the above relationship is observed in a high-concentration range where higher coagulation of the centers is likely to happen. (auth)

19443 THE PROPERTIES OF GRAFT POLYMERIZED POLYVINYL ALCOHOL FIBERS. Waichiro Tsuji, Ryozo Kitamaru, and Terumichi Ichiba (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 86-96(Mar. 1962). (In English)

Styrene and methylmethacrylate were graft polymerized onto polyvinyl alcohol fibers with Co^{60} γ radiation, and some properties of those graft polymerized fibers were examined. It was found that some favorable properties such as thermoplasticity, elasticity, and water-resistivity could be imparted to polyvinyl alcohol fibers by this graft polymerization without lowering the tensile strength and softening temperature very much. (auth)

19444 THE EFFECT OF IRRADIATION ON THE CATALYTIC PROPERTIES OF COPPER. P. Tétényi and L. Babernics (Isotopes Inst., State Committee for Atomic Energy, Budapest). Doklady Akad. Nauk S.S.S.R., 143: 616-7(Mar. 21, 1962). (In Russian)

Samples of copper catalyst were given a total neutron irradiation of 3×10^{18} neutrons/cm^2 in a neutron reactor under an argon atmosphere. The specific activity of the samples was 2.5 to 3.5 curies/g directly after irradiation, but the catalytic experiments on the dehydrogenation of cyclohexane were carried out with samples having an activity of <1 μC/g. The apparent activation energy was 41 kcal/mol for the unirradiated catalyst. The catalytic activity of the irradiated copper was increased significantly with an apparent activation energy of 17.5 and 18.1 kcal/mol for two of the irradiated catalysts. Gamma irradiation of a copper catalyst by means of a Co^{60} source did not improve the catalytic properties of the sample. An irradiated copper sample was dissolved in nitric acid, and the catalyst was reformed by the standard procedure. The catalytic activity remained high. Structural changes as a result of irradiation are not responsible for the enhanced catalytic activity. The problem requires further study. (TTT)

19445 ELECTRON SPIN RESONANCE IN γ-IRRADIATED TRIGLYCINE SULFATE. D. W. Ovenall and K. A. Mueller (Battelle Memorial Inst., Geneva). Helv. Phys. Acta, 34: 786-90(1961). (In English)

A study was made to determine the nature of the paramagnetic centers in irradiated triglycine sulfate, to investigate their possible connection with the permanent bias, and to use the spectra to study molecular motion above and below the Curie temperature. The crystals were irradiated at room temperature at γ energies of 1 Mev to a dose of 10^6 rad. The spectra, determined in a superheterodyne spectrometer operating at 9 kmc/sec, were centered on the free spin g value of 2.00 and showed considerable hyperfine structure which was strongly orientation dependent. Typical spectra taken at the orientation in the ac plane corresponding to the maximum splitting of the proton bonded to the "radical" carbon atom are illustrated. (J.S.R.)

19446 INVESTIGATION OF RECOMBINATION PROCESSES IN NEUTRON-IRRADIATED Ge-pnp TRANSISTORS. H. Bilger (Universität, Basel). Helv. Phys. Acta, 34: 909-28(1961). (In German)

Recombination processes in Ge were investigated by irradiating transistors with fast neutrons of a known spectrum, and thereby increasing the rate of recombination. Applying the Hall-Shockley-Read model to describe the influence of the generated recombination centers on several transistor parameters, good agreement was obtained. The mean of three different methods of measurement gives a Hall-Shockley-Read level at $E_t - E_i = 0.11$ ev. None of the measurements differed from the mean by more than 1 to 2 kT. However, large differences in the values of the lifetimes were found. The measurements, all made with the same transistor, show that there exists an unexpected great range (of the order of 10^3) of lifetimes τ_{p0}. This could be explained by a strongly field-dependent Shockley-Read capture cross section. (auth)

19447 METHODS OF PREDICTING RADIATION-INDUCED CHANGES IN THE MECHANICAL PROPERTIES OF HIGH POLYMERS. E. G. Fritz (General Dynamics Corp., Fort Worth, Tex.). J. Polymer Sci., 57: 629-39 (Mar. 1962).

A discussion is presented of the various problems associated with the formulation of predictive techniques relating to the mechanical response of high polymers to

radiation. In particular, dosimetric difficulties and errors arising from disregard of sample variations are analyzed. Criteria for the engineering evaluation of radiosensitivity are examined. The usefulness of rank correlation in preliminary analysis of radiation effects data is outlined. Typical examples are given of explicit correlations between properties, the application of statistical kinetic theory, and semiempirical and empirical response relationships. The limitations of the various approaches are discussed. (auth)

19448 FIELD TESTS ON A RADIATION-RESISTANT GREASE. James G. Carroll (California Research Corp., Richmond), Robert O. Bolt, Charles E. Cunniff, and Peter T. Heyl. Lubrication Eng., 18: 64-70(Feb. 1962).

The grease is made from an alkylbiphenyl gelled with a sodium amate. Bearing performance is outstanding without radiation; data are cited at 250, 300, and 350°F. Resistance to ionizing radiation is good. Changes in familiar properties are shown before and after a static gamma dose of 7×10^8 rads. The grease was tested in a reactor; in the presence of neutrons and gammas. Several tests were made in small motors at 6400 rpm. In the last test, the grease permitted operation for about 2500 hours; the equivalent absorbed dose is 34×10^8 rads. (auth)

19449 STRAIN AGING AND NEUTRON IRRADIATION OF LOW-CARBON OPENHEARTH STEELS. Friedrich Erdmann-Jesnitzer, Paskal Paskaleff, and Harald Flach. Neue Hutte, 6: 762-6(Dec. 1961).

An investigation is made of strain hardening by notch-impact testing from –80 to 20°C, tensile properties, hardness, and electrical conductivity of tensile deformed and 80 to 800°C annealed specimens of MSt3b and MSt3u steels with and without neutron radiation. Results are presented of the effects of radiation. (Rev. Metal Lit., 19: No. 4, Apr. 1962)

19450 THE ENERGY DISTRIBUTION OF THE PRIMARY ATOMS IN COPPER IN IRRADIATION WITH FAST MONOENERGETIC AND REACTOR NEUTRONS. Heinrich Wollenberger (Kernforschungsanlage, Julich, Ger.). Nukleonik, 4: 25-30(Feb. 1962). (In German)

The energy distribution of the primary atoms in copper for 1.5- and 3.7-Mev and reactor neutrons was calculated with the spectrum given by Holmes et al. for Channel 12 of the ORNL Graphite Reactor by application of the measured differential cross section for elastic neutron scattering. For the same neutron energies the number of radiation-induced Frenkel defects were determined by the Kinchin and Pease methods. The energy distribution in the case of reactor neutrons up to a primary energy of 60 kev can be represented by two simple functions. As total cross section for the production of primary atoms the value 5.7b was obtained for reactor neutrons, 2.9b for 1.5-Mev neutrons, and 2.3b for 3.7-Mev neutrons. According to Kinchin and Pease 75 Frenkel pairs/primary atom should be produced in reactor irradiation, 650 in irradiation with 1.5-Mev neutrons, and 640 in irradiation with 3.7-Mev neutrons. The values obtained were compared with the experimental results of Blewitt et al. (tr-auth)

19451 FORMATION OF COLOR CENTERS IN SODIUM SILICATE AND QUARTZ GLASSES UNDER THE ACTION OF GAMMA RADIATION. G. V. Byurganovskaya and N. F. Orlov. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 151-4(Feb. 1962).

The dependence of the intensity of the induced absorption bands in fused quartz and sodium silicate glasses on the γ dose is studied, as well as the influence of cerium, antimony, arsenic, manganese, iron, and lead additives on the properties of the absorption bands of sodium silicate glasses. The uniformity of the color centers produced in glass under the influence of radiation is demonstrated. Anomalies are noted in the dependence of the optical absorption curves on the radiation dose in the case of fused quartz and sodium silicate glass treated with Fe_2O_3 at doses of approximately 10^5 and 10^8 roentgens. It is suggested that these anomalies are due to the presence of impurities or to specific melting conditions. (auth)

19452 KINETICS OF CARBON PRECIPITATION IN IRRADIATED IRON. H. Wagenblast and A. C. Damask (Brookhaven National Lab., Upton, N. Y.). Phys. and Chem. Solids, 23: 221-7(Mar. 1962). (BNL-5594). (In English)

Iron containing approximately 0.01 wt % carbon was irradiated at different times and temperatures, and the amount of carbon in solution was measured by torsion pendulum internal friction. Isothermal annealings after irradiation for 12 days at 200°K showed that the irradiation accelerated the disappearance of carbon from solution by about three orders of magnitude over the thermal rate. The extent of the accelerated decay is a function of irradiation time, and after 12 days irradiation the peak decayed to background level. The decay curves are all second order with an activation energy of the diffusion of carbon in iron. After a 4 hr irradiation at 57°C, however, the decay was accelerated by only about one order of magnitude and the decay rate is not affected by further irradiation. (auth)

19453 SHALLOW ELECTRON TRAPS IN SINGLE CRYSTALS OF RUTILE STUDIED BY X-RAY IRRADIATION USING LOW FREQUENCY DIELECTRIC MEASUREMENTS. K. G. Srivastava (Univ. of Allahabad, India). Physica, 28: 368-73(Apr. 1962).

Defect structure in single crystals of rutile was studied by dielectric measurements at 2 cps and above, before and after irradiation with hard x rays. The results were analyzed by a Cole-Cole plot, which is a circle with its center shifted away from the dielectric constant axis. X irradiation shifts the center of the Cole-Cole plot toward the dielectric constant axis, indicating a decrease in distribution of relaxation times by evacuation of electrons from their shallow traps, which after release produce interfacial polarization. An attempt was also made to calculate the a-c behavior from d-c data, but the errors at frequencies of measurement were too high, thus defying comparison with experimental data. (auth)

19454 THE RESOLUTION OF AVALANCHE DISCHARGES IN SILICON p-n BARRIER LAYERS UNDER PARTICLE IRRADIATION. I. Ruge (Technische Hochschule, Munich). Z. Naturforsch., 16a: 1398-1400(Dec. 1961). (In German)

As a result of the radioinduced charge carrier avalanches, the direct current mean value of the barrier current is altered in the break-through range under irradiation, and this variation can be used as a measurement of the radiation intensity. More accurate measurements on the resolution of carrier avalanches under irradiation are given. The Si diode used in the study had break-through voltages between 50 and 200 v. The number and amplitude of the break-through pulses and the relative radiation sensitivity were determined as a function of the break-through voltage. The increase of the break-through pulse with the irradiation dose was shown. The consequences of the experimental results are discussed in some detail. (J.S.R.)

19455 THERMOLUMINESCENCE AND MAGNETIC PROPERTIES OF IRRADIATED SODIUM CHLORIDE. A. Choudhury (Indian Inst. of Tech., Kharagpur). Z. Physik, 166: 577-81(1962). (In English)

The diamagnetic susceptibility of sodium chloride crystal decreases on irradiation with x rays and γ rays. This is due to the induced paramagnetic centers in the crystal. The difference in diamagnetic susceptibility of the crystal before and after irradiation obeys Curie law. On thermal bleaching the diamagnetic susceptibility recovers its original value. The changes in magnetic susceptibilities which occur at different stages of thermal bleaching are found to have correspondence with the integrated intensity of thermoluminescence. It is concluded that the destruction of F centers alone can not account for the intensity of thermoluminescence or changes in magnetic property. (auth)

PHYSICS

General and Miscellaneous

Refer also to abstracts 18805, 18924, 18934, 19270, and 19279.

19456 (AD-263112) RESEARCH IN ELECTRON EMISSION FROM SEMICONDUCTORS. Report No. 11. Third Quarterly Report, April 1, 1961 to June 30, 1961. R. E. Simon, W. H. McCarroll, W. E. Spicer, and J. J. Quinn (David Sarnoff Research Center, Princeton, N. J.). Contract DA36-039-sc-87388. 53p.

Theoretical and experimental studies are reported in the area of electron energy loss interactions and surface effects in semiconductors. These include a theoretical investigation of electron–electron interactions in semiconductors, velocity distribution measurements of photoelectrons from cesium-treated silicon, studies of the effect of heat treatment on crystals as a function of etching procedure, studies of the effect of controlled deposition of cesium on unclean silicon surfaces, measurements of photoemission from silicon crystals cleaved in vacuum and treated with cesium. In addition, the first attempts to produce materials for large area germanium hot electron emitters are described. (auth)

19457 (AD-263818) RESEARCH AND DEVELOPMENT ON THERMOCOUPLE ENERGY CONVERTERS (PHASE II). Quarterly Progress Report No. 1, April 12–July 12, 1961. W. J. van der Grinten (General Electric Co. Electronics Lab., Syracuse, N. Y. and General Electric Co. Light Military Electronics Dept., Utica, N. Y.). Aug. 15, 1961. Contract DA-30-069-501-ORD-3294. 30p.

Research concerns the development techniques for fabricating, in quantity, good quality n- and p-type thermoelectric PbTe cells, and the assembling of these cells to form two thermoelectric devices which will meet military requirements. Attention was focused entirely on the fabrication and some measurements aspects of thermoelectric PbTe cells. In conjunction with a brazed seal to be fabricated later, a new simple casting technique for the filling of elements was successfully developed. Subject to experimental verification of electrical output values under prescribed operating conditions, this new filling technique promises to yield excellent n-type elements. On the other hand the reduction of possible contact resistances of p-type elements may require additional attention. (auth)

19458 (AD-265360) HEAT DIODE CONVERTER. Interim Scientific Report No. 1, May 1, 1961 to July 31, 1961. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Aug. 20, 1961. Contract AF33(616)-8262. 86p.

Information and data are presented which were obtained in a study of emission of Cs-coated refractory metals, electron scattering by Cs atoms, space charge limited currents in thermionic diodes at high Cs pressure, potential distributions in high-pressure Cs thermionic diodes, thermionic electron emission, efficiencies of thermionic diodes, and testing of seals for diodes. (J.R.D.)

19459 (AD-265365) THERMOELECTRICITY QUARTERLY PROGRESS REPORT NO. 3, MAY 11, 1961–AUGUST 11, 1961. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Contract NOBS-84317. 120p.

The solid solutions formed by the addition of $TlSbTe$ or $TlBiTe_2$ to GeTe, SnTe, and PbTe were investigated. The most significant result was the observation that the addition of about 10% $TlBiTe_2$ to GeTe gives a material which is near optimum doping. This material has a lower transition temperature from cubic to rhombohedral symmetry and might provide an answer to the troublesome cracking observed in thermocouples fabricated from pure GeTe. (auth)

19460 (AD-265857) OPTIMIZATION OF THERMOELECTRIC ENERGY CONVERTERS. Bimonthly Progress Report No. 5, December 15, 1960–February 14, 1961. L. Luft, ed. (General Electric Co. Aircraft Accessory Turbine Dept., Lynn, Mass.; General Electric Co. General Engineering Lab., Schenectady, N. Y.; and General Electric Co. Electronics Lab., Syracuse, N. Y.). Contract NObs 78403. 53p.

Work on a system with saturated steam at 533°K as the heat source and 291°K water as the heat sink was completed using a computer program. $MgO-TiO_2$ was made into capsule bodies and used for successful encapsulation of lead telluride. A Seebeck coefficient of Mg_3Sb_2 was measured at 300 to 1250°K. The values ranged from 100 to 159 $\mu v/°K$. Electrical measurements were performed on $CrSb_{0.9}Se_{0.1}$, including Seebeck coefficient and electrical resistance. Several II-IV compounds were prepared and their thermoelectric properties were measured. (auth)

19461 (AD-268286) HEAT DIODE CONVERTER. Interim Scientific Report No. 2, August 1, 1961 to October 31, 1961. (Westinghouse Electric Corp. Research Labs., Pittsburgh). Nov. 20, 1961. Contract AF33(616)-8262. 100p.

Results of research and development are reported on thermionic diode currents in transverse magnetic fields, fabrication of electron beam heated button-cathode cells, lifetime and efficiency of thermionic energy converters, and calculation of thermionic emission energy conversion efficiency. (J.R.D.)

19462 (AD-268422) RESEARCH IN ELECTRON EMISSION FROM SEMICONDUCTORS. Report No. 12, Quarterly Report No. 4, July 1, 1961 to September 30, 1961. R. E. Simon, W. H. McCarroll, J. J. Quinn, E. K. Gatchell, and W. E. Spicer (David Sarnoff Research Center, Princeton, N. J.). Contract DA 36-039-sc-87388. 28p.

Efforts were directed toward developing a large-area, front-surface hot electron emitter of silicon. This work included the study of cesium–silicon contacts, the diffusion of thin n-layers into silicon and the stripping of portions of the thin diffused n-type layer, and an attempt to observe hot electron emission from an emitter made by diffusion. In addition, an attempt was made to observe electron emission from cesium-treated silicon by applying high voltage pulses across a crystal containing no junction. Theoretical calculations of the rate of energy loss of hot electrons in a metal are also reported. (auth)

19463 (AFCRL-984) MICROWAVE DETERMINATION OF AFTERGLOW TEMPERATURES AND ELECTRON COLLISION FREQUENCIES IN NITROGEN AND OXYGEN. Technical Summary Report No. 2. D. Formato and A. Gilardini (Selenia S. p. A., Rome). Apr. 30, 1961. Contract AF61(052)-39. 19p. (AD-268506)

The results of microwave attenuation, phase shift, and radiation temperature measurements in the late afterglow of pulsed O discharges of various types are discussed

from the point of view of the collision frequency and G-factor determination. A new general theory for the evaluation of the G-factor from the radiation temperature increases under microwave heating conditions is reported. The values computed with this theory in N are in very good agreement with previous diffusion measurements by Crompton and Sutton, whereas in O the agreement with measurements by Healey and Kirkpatrick is such less satisfactory. (auth)

19464 (ARL-62-305) DESORPTION OF MOLECULES BY ION-BEAM BOMBARDMENT. F. F. Carini and A. E. Judkins (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Mar. 1962. Contract AF33(616)-5291. 42p.

An experimental apparatus was devised and built which produces ions of relatively low energy to desorb molecules from a surface by bombardment. Monolayers of stearic acid and stearyl alcohol were desorbed from Pt, Cu and stainless steel substrates. Ar ions were formed in an electron beam and the positive ions accelerated toward the negative electrode. The bombardment of the surface was continued at a constant energy level until desorption had become vanishing small. In this manner the threshold energy necessary for desorption was measured. (auth)

19465 (JPL-TR-32-101) COMPARISON OF FISSION ELECTRIC CELL GEOMETRIES. C. J. Heindl (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Sept. 1, 1961. Contract NASw-6. 22p.

The relative power-to-weight ratios for fission-electric cells of plane, spherical, and cylindrical geometries are compared. It is shown that for systems of equal power output, the choice of cell geometry does not greatly affect the total weight. (J.R.D.)

19466 (LA-2667) MIXTURE THEORIES APPLIED TO SYSTEMS OF RIGID SPHERES. Z. W. Salsburg and Wildon Fickett (Los Alamos Scientific Lab., N. Mex.). Jan. 1962. Contract W-7405-Eng-36. 61p.

Current theories of nonelectrolyte fluid solutions were tested on mixtures of hard spheres, which accentuated the problem of unequal sizes, and also had the advantages of simplicity and an exactly known force law for all interactions. The analytical and numerical results for the different theories were compared with each other and with the available Monte Carlo results. The results did not agree even on the sign of ideal mixing; appreciable deviations in both directions were predicted at nearly all pressures. At low to medium densities, ideal mixing gave nearly correct results. At higher densities, except for widely spaced upper and lower bounds, nothing is known about the correct solution of the problem. (auth)

19467 (MRL-104) THEORY OF DIRECT EXCHANGE IN FERROMAGNETISM. A. J. Freeman (Watertown Arsenal. Materials Research Lab., Mass.) and R. E. Watson (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). July 1961. Contract DA-5-93-32-001. 56p. (AD-267668)

Results of investigation are presented on the role of direct exchange as the mechanism responsible for ferromagnetism. The direct exchange integral J is considered for two cases for which J is rigorously defined: (1) A pair of atoms with a single electron per atom, and (2) a single hole in otherwise shells. The direct exchange parameter J is found to be large and negative for the two electron case and negative, but smaller, for the two holes case, whereas for ferromagnetism it should be positive. From this it is concluded that either the direct exchange mechanism is not the dominant source of the ferromagnetism of the transition metals or that the direct exchange model is an inappropriate description of their magnetic behavior. A more exact model of direct exchange is discussed, as are some of the problems inherent in carrying it out. (auth)

19468 (NASA-TN-D-1176) THE THERMOELECTRIC POWER OF SEMICONDUCTORS. F. E. Geiger, Jr. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). May 1962. 11p.

D. ter Haar has shown that simple kinetic theory can be used to derive separate approximate expressions for the transport properties of metals and semiconductors. Using ter Harr's method and notation, the equation is given for the current density in a semiconductor when both thermal and electric gradients are present, and for the field produced by both types of carriers. Calculations are given, based on classical statistics, for the derivation of the thermoelectric power of a semiconductor. Careful examination of the equation for the current density j_x reveals that terms neglected by ter Haar are important. It is precisely these terms which, with the dominant term found by ter Haar, account for the exact expression for the thermoelectric power, except for some numerical factors. The approximate kinetic theory results are examined in the light of the rigorous calculations of others. (auth)

19469 (NP-11613) MECHANISMS FOR VIBRATIONAL RELAXATION AT HIGH TEMPERATURES. S. H. Bauer and S. C. Tsang (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). Apr. 1962. Contract AF49(638)-716. 21p.

Attention is called to several mechanisms which effectively couple translational and vibrational motions through the intermediary of chemical reactions. It is proposed that these processes lead to shorter relaxation times than those expected from direct energy exchange via inelastic collisions. Semiquantitative estimates were made, and relaxation times for these different processes were compared as a function of the reciprocal temperatures. At high temperatures, it is proposed that the transfer of energy from rotations to vibrations at approximately constant total energy can be induced by distant collisions. These serve only to balance the change in rotational angular momentum. Such events provide alternate paths for rapid vibrational relaxation, particularly for the upper vibrational levels, and may account for the discrepancy between the observed and calculated rates of dissociation. (auth)

19470 (NP-11617) DRIFT VELOCITIES OF SLOW ELECTRONS IN KRYPTON, XENON, DEUTERIUM, CARBON MONOXIDE, CARBON DIOXIDE, WATER VAPOR, NITROUS OXIDE, AND AMMONIA. Scientific Paper 62-908-113-P4. Technical Report 11. J. L. Pack, R. E. Voshall, and A. V. Phelps (Westinghouse Electric Corp. Research Labs., Pittsburgh). Mar. 19, 1962. Contract NONR 2584(00). 30p.

Drift velocities of electrons in krypton, xenon, deuterium, carbon monoxide, carbon dioxide, water vapor, nitrous oxide, and ammonia were measured for E/p values between 2.5×10^{-4} and 30 volts/cm-mm Hg at temperatures between 77 and 443°K. The data were obtained from measurements of electron transit times in a double-shutter drift tube. Values of the momentum transfer cross section as a function of electron energy for electrons with energies between about 0.003 and 0.08 ev are obtained which are consistent with the measured drift velocities for thermal electrons in all the gases reported. (auth)

19471 (R62SD27) ELECTROHYDRODYNAMIC POWER GENERATION. EXPERIMENTAL STUDIES. John M.

Smith and W. Fried (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Mar. 1962. Contract AF33(616)-7539. 19p.

A series of experiments was performed to establish the feasibility of generating electrical power by means of a generator based upon the principle of the Van de Graff generator, the primary difference being that the charge is transported in a moving gas rather than on a moving belt. The experiments were performed using a corona ionization source and showed that a net electrical output could be obtained; thereby, establishing the feasibility of such a generator. (auth)

19472 (RAD-TR-62-19) EXPLORATORY RESEARCH ON THE VAPORIZATION OF SOLIDS. Final Report. Charles H. Leigh (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). May 1, 1962. Contract NOnr-3051(00). 64p.

Work is described which is concerned with the development of a means for investigating the vaporization of solids. In order to identify the products produced in a vaporization process, particularly that from a plasma, a mass spectrometer-molecular beam system was developed. The experimental data obtained for several organic and refractory materials are presented. It is concluded that a metallic plasma source, produced by means of an exploding wire, may be placed directly within a time-of-flight mass spectrometer for such a purpose. The metallic plasma system was shown to be a feasible method for studying high speed, high temperature decomposition processes. By a combination of the molecular beam data from both shock tubes and the metallic plasma, valuable information on high-temperature decomposition processes may be obtained. (auth)

19473 (RADC-TN-61-196) RELATIVISTIC BEAM-WAVE INTERACTIONS. Technical Report No. 48. Joseph E. Rowe (Michigan. Univ., Ann Arbor. Electron Physics Lab.). June 1961. Contract AF30(602)-2303. 48p. (AD-266569; ORA-03736-7-T)

The results of the special theory of relativity were used to modify the nonlinear interaction equations for linear-beam devices to account for relativistic mass changes when the electron velocity is a significant fraction of the velocity of light. The effect of mass changes on gain and efficiency was evaluated, and it was found that the gain is reduced and the efficiency increases rapidly as ke approaches one. The velocity spread in the stream was independent of the voltage. The harmonic current amplitudes and optimum drift distances were calculated for the relativistic klystron. It was found that as ke approaches one the klystron behaves according to a ballistic theory. (auth)

19474 (TID-14386) [ANNUAL PROGRESS REPORT ON PHYSICS, JANUARY 1, 1961–JANUARY 31, 1962]. E. R. Beringer, D. A. Bromley, et al. (Yale Univ., New Haven. Heavy Ion Accelerator Lab.). 80p. Contract [AT(30-1)-2726].

A review is presented of studies conducted on the Heavy Ion Linear Accelerator. Half lives are given for Ba^{123}, Ba^{124}, Ba^{125}, Ba^{126}, Ba^{127}, and Cs^{123}. An outline is given of facilities, accessories, and components of an electron accelerator. Photonucleon and nuclear structure studies using this accelerator are discussed, including a study of the width of the 2.18-Mev level of Li^6. A proposal is outlined for a 20-Mev electrostatic accelerator. Discussions are given of the production of 100%-polarized deuteron beams, thermal diffusion studies, reactions $p + \bar{p} \rightarrow \Sigma^+ + \bar{\Sigma}^-$ and $p + \pi^+ \rightarrow \pi^+ + \pi^0 + p$, the development of a less-than-1-Bev proton linear accelerator, and meson pair production by photons or electrons. (T.F.H.)

19475 (TID-15638) THE MEASUREMENT OF THE K-SERIES FLUORESCENCE YIELD OF ARGON AND In^{113} WITH A PROPORTIONAL COUNTER SPECTROMETER (thesis). Gordon Ray Harrison (Vanderbilt Univ., Nashville). June 1954. 72p.

The K-series fluorescence yield of argon gas was measured using a proportional counter spectrometer by the method of Cu^{65} x-ray excitation to be 0.0813 ± 0.0077 which compares very closely with the theoretical value of 0.081. The K-series fluorescence yield of In^{113} due to nuclear transformations was measured using the same proportional counter spectrometer to be 0.835 ± 0.021. This value compares well with the proposed theoretical value of 0.82. A proportional counter was developed which may be used in the study of numerous radio-nuclear problems. It has a very wide voltage region of proportionality and a peak to half peak width resolution as low as 13% on the 8 kev Cu^{65} x-ray transition. It was designed so that it could be calibrated from the outside and used in coincidence with a scintillation crystal spectrometer and together the two instruments could be used to clear up many uncertainties in decay schemes. It can be easily adapted to operate at atmospheric pressure, under atmospheric pressure, or above atmospheric pressure. (auth)

19476 (TID-15642) QUARTERLY PROGRESS REPORT NO. 65 [ON ELECTRONICS]. H. J. Zimmermann, G. G. Harvey, and W. B. Davenport, Jr. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Apr. 15, 1962. Contract AT(30-1)-1842, et al. 312p.

Research progress is reported on physical electronics, biophysical chemistry, microwave spectroscopy, optical and infrared Masers, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, radio astronomy, noise in electron devices, plasma physics, plasma electronics, plasma magnetohydrodynamics and energy conversion, statistical communication theory, processing and transmission of information, advanced computation research, mechanical translation, linguistics, communications biophysics, neurology, cutaneous sensory mechanisms, and network synthesis. (M.C.G.)

19477 (TID-15694) THE PHOSPHORESCENCE OF X-RAY EXCITED FLUORITE FROM −4.5°C TO 120°C (thesis). Ross L. Floyd (Vanderbilt Univ., Nashville). Jan. 1954. 90p.

Fluorite phosphorescence excited by x radiation at constant temperatures, in the range from −4.5 to 120°C, was observed. The time-intensity relationship was found to be representable by a summation of several components, each of which decreased exponentially with time at a different rate. The components were separated graphically and the half-life determined for each. The electron trap depth associated with each component was calculated from the corresponding half life. In every respect observed, fluorite phosphorescence was found to be similar to that of calcite. The single exception was that of absolute intensity of the emission. Fluorite phosphoresced less than calcite by a factor in the order of magnitude of 100. The electron trap depth distribution was found to be very nearly the same for the two crystals. The relationship between temperature and time duration of tests previously noted for calcite was true for fluorite. An anomolus behavior was observed in fluorite phosphorescence which suggested possible movement of an inter-related group of electron trap sites. It is suggested that an extension of this observation of fluorite through a

greater temperature range would better indicate the nature of the trap depth distribution and any differences from that of calcite that might exist. (auth)

19478 (TID-15703) A MEASUREMENT OF THE K JUMP AND THE K SHELL FLUORESCENCE YIELD OF TIN (thesis). Harold Homer Nichols (Vanderbilt Univ., Nashville). June 1956. 28p.

The K adsorption jump and the K-series fluorescence yield of tin were measured using a scintillation spectrometer by the method of x-ray excitation. X-ray production, focusing, and detection are described. Results are presented in graphical and tabular form. (M.C.G.)

19479 (UCRL-6772) DEPOSITION OF MOLECULAR AND ATOMIC BEAMS ON SURFACES (thesis). Forrest S. Baker and Gilbert O. Brink (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 14, 1962. Contract W-7405-Eng-48. 30p.

The adsorption probabilities were measured for a thermal potassium beam impacting on twenty different target materials. These measurements when included in the general body of previously published data permitted the derivation of several empirical relations involving binding energies, adsorption coefficients, and heats of formation. These relations may find application in predicting other coefficients and binding energies. Thus, the experiments usually required in the search for suitable beam-collector materials may be significantly reduced. (auth)

19480 (UCRL-10029) TOPICS IN STATISTICAL MECHANICS OF FLUIDS (thesis). Fortunato Danon (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 23, 1962. Contract W-7405-Eng-48. 67p.

A method was developed for the derivation of improved intermolecular potentials from empirical second virial coefficient data together with the acentric factors of the fluids. The Kihara core model was considered and relationships were derived between the acentric factor and the core size for several shapes. The resulting cores for CH_4, CF_4, $C(CH_3)_4$, C_6H_6, and N_2 are reasonable in view of semi-quantitative theoretical expectations, but the core for CO_2 is somewhat larger than expected. An approximate treatment is given which combines the Kihara core model with an electric quadrupole interaction. The core calculated for CO_2 on this model including the quadrupole moment is of a reasonable size. A core model intermolecular potential for argon is presented. Experimental data available on the second virial coefficient of the gas permitted a check of the potential for the pair interaction. The calculated values for this model yielded considerably better agreement with the observed values than those for the Lennard-Jones potential. The cohesive energy and the nearest neighbor distance in the crystal were also calculated. The effect of the zero point vibrational energy was considered following the method given by Corner. Deviation from the observed values for the crystal properties are discussed in connection with the assumption of the pairwise additivity of the potential. The relative stabilities of the crystal structures were investigated and the hexagonal close-packed was calculated to be the most stable one. Recent experimental results allow a more precise check than was previously possible on the conformity of argon and xenon to the principle of corresponding states. The data showed agreement within experimental error except at very high pressures where small differences were found for some but not for other measurements. A simple theory for the evaluation of the condensation coefficient of liquids is presented. The condensation coefficient was calculated by assuming that the fraction of molecules reaching the surface with a kinetic energy higher than the emission energy, is able to leave the surface. The emission energy was obtained from the internal heat of vaporization. The agreement with the experimental data is satisfactory. (auth)

19481 (WIS-OOR-31) SOME SOLUTIONS OF THE BOLTZMANN EQUATION. M. J. Offerhaus (Wisconsin. Univ., Madison. Theoretical Chemistry Lab.). Nov. 6, 1961. Contract DA-11-022-ORD-2526. 21p. (AD-267035)

One-particle velocity distribution functions for a dilute gas, were found by solving the Boltzmann equation as an initial value problem. The departure of the distribution from the corresponding normal solution was developed in a series, each term being subject to relaxational decay. The pace of this process, called the kinetic stage, is set by the inverses of the lowest positive eigenvalues of the linearised collision operator 0, which serve as relaxation times. During the hydrodynamical stage which follows, the inverse eigenvalues of 0 act as coefficients in the distribution function. The transition from the kinetic to the hydrodynamical stage is marked by the establishment of equilibrium between the effects of streaming and of collisions on the transport currents. During the hydrodynamical development, these currents retain stationary values proportional to the existing gradients of mean velocity and temperature. (auth)

19482 PVT RELATIONS IN He^4 NEAR THE MELTING CURVE AND THE λ-LINE. E. R. Grilly and R. L. Mills (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N. Y.), 18: 250-63(May 1962).

Measurements on He^4, from 1 to 2°K, were made of the melting pressure, the volume change on melting, and the compressibility and thermal expansion coefficients of the liquid near melting. The $\alpha-\gamma$ transformation in the solid was studied, and values of the transformation pressure and associated volume change are reported. The PVT properties of the liquid in the high pressure region of the λ-line were investigated. The compressibility vs pressure has a maximum at the λ-pressure, and the thermal expansion vs temperature has a minimum at the λ-temperature. The thermal expansion is negative below $(T_\lambda + 0.08)$°K. Estimates indicate negative values for the thermal expansion in the solid. (auth)

19483 MAXWELL EQUATIONS IN NONUNIFORMLY MOVING MEDIA. Allan N. Kaufman (Univ. of California, Livermore). Ann. Phys. (N. Y.), 18: 264-73(May 1962).

Covariant Maxwell equations for material media in arbitrary motion are derived by means of a statistical average of the microscopic equations. Special relativistic considerations are used throughout, even though accelerated motion is treated. The Minkowski form, originally derived for uniform motion only, is found to be generally valid for non-uniform motion, if the macroscopic quantities are suitably defined. In particular, the covariant polarization is defined in terms of the molecular electromagnetic dipole moments. (auth)

19484 MOMENTUM TRANSFER TO ATOMS BOUND IN A CRYSTAL. Bruria Kaufman and Harry J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel). Ann. Phys. (N. Y.), 18: 294-309(May 1962).

A complete self-contained calculation is given for the relation between the momentum and energy transferred to the lattice in processes involving the recoil of a single atom (emission, absorption, or scattering of photons or neutrons). The calculation, using Ott's theorems, is exact and leads to Lamb's original results for a harmonic crystal in thermal equilibrium. Detailed proofs of Ott's rele-

vant theorems are given. The height of the Mössbauer peak is calculated, showing small deviations from the Debye–Waller factor usually used. (auth)

19485 METHOD FOR PREPARING LOW-ACTIVITY POLONIUM α-RAY SOURCES. I. N. Plaksin, Yu. S. Deev, and L. P. Starchik. Atomnaya Energ., 12: 322-4(Apr. 1962). (In Russian)

Preparation of low-activity α sources by electrochemical or sublimation techniques usually presents serious experimental problems. In order to overcome these difficulties, a Po source was prepared by making use of the recoil of Po^{210}; a low-activity α-emitting preparation is formed by precipitating the Po atoms onto a supporting surface. As the number of Po atoms removed from the material is proportional to the time if the time is kept sufficiently short in comparison with the half life of the material, the specific activity of the new source is a function of the time of contact between the original preparation and the supporting plate. The recoil atoms leaving the surface lose their electrons because of ionization and interaction with molecules and electrical methods may be used. Thus, a 100 v/mm charge was applied, using the supporting plate as the negative electrode. This method increased the rate of deposition by a factor of much more than 10, making it possible to prepare even high-activity sources within relatively short time periods. (TTT)

19486 NOTE ON A PROBLEM OF MAGNETOHYDRODYNAMIC STABILITY. W. I. Axford (Defence Research Board, Ottawa). Can. J. Phys., 40: 654-6(May 1962).

A more general solution of magnetohydrodynamic stability, in which the vortex sheet is a current sheet with no normal component of the magnetic field and the fluid is assumed to be perfectly conducting, is obtained. The solution is of interest because the outer surface of the earth's magnetosphere forms a current-vortex sheet and it is desired to know whether or not this surface is stable. (P.C.H.)

19487 ORDERS OF MAGNITUDE IN MAGNETOHYDRODYNAMIC TURBULENCE. Pierre Lecocq. Compt. rend., 254: 1198-1200(Feb. 12, 1962). (In French)

It is shown that from a restricted number of hypotheses, the equations of magnetohydrodynamic turbulence of an incompressible conductor fluid can be simplified in an appreciable fashion. (tr-auth)

19488 CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN COPPER, SILVER, AND GOLD. Claude Gout, Ferdinand Pradal, and René Simon (Laboratoire d'Optique Électronique du C.N.R.S., Toulouse, France). Compt. rend., 254: 1233-5(Feb. 12, 1962). (In French)

The characteristic energy losses of electrons in Cu, Ag, and Au were studied in order to investigate the causes of the considerable differences which exist among the published values. A large role is played by contamination, which can be lessened by heating the samples to 300°C. The results obtained under these conditions are given. The spectra are composed of fine rays which cannot be separated if the samples are contaminated. (tr-auth)

19489 NEW INVESTIGATIONS ON THE TWO FLUORESCENT EMISSION BANDS OF COPPER-ACTIVATED ZINC SULFIDE. Marguerite Bancie-Grillot (Faculté des Sciences, Paris). Compt. rend., 254: 1247-9(Feb. 12, 1962). (In French)

The presence of oxygen traces in the calcination atmosphere of ZnS(Cu), with very low initial oxide concentration, facilitates the diffusion of the activation in the lattice and transforms luminogenic centers with blue emission into centers with green emission. Larger quantities of oxygen also produce a displacement of the two bands by several angstroms toward the long wave lengths. (tr-auth)

19490 THE UNIQUENESS OF THE SOLUTIONS OF THE EQUATIONS OF MAGNETOHYDRODYNAMICS. David E. Edmunds. Compt. rend., 254: 1377-9(Feb. 19, 1962). (In French)

A condition sufficient for the uniqueness of weak solutions of magnetohydrodynamic equations of the third order was established. (tr-auth)

19491 THE LUMINESCENT EMISSION OF CADMIUM SULFIDE CRYSTALS EXPOSED TO ELECTRON BOMBARDMENT. François Davoine and Robert Gauthier (Institut National des Sciences Appliquées, Lyon). Compt. rend., 254: 1403-5(Feb. 19, 1962). (In French)

In a series of studies on the luminescence of cadmium sulfide exposed to electron bombardment, it was found that the spectral distribution of the luminescent emission varies from one point to another of the irradiated surface. In a general fashion, a red emission and a green emission, as well as some zones emitting intermediate wave lengths, are observed. The temperature of the sample (up to 300°C) always causes an increase of the green light at the expense of the other wave lengths. (tr-auth)

19492 ANGULAR DISTRIBUTION OF PHOTONS SCATTERED IN THE DOUBLE COMPTON EFFECT. Guy Burdet (Université, Lyon). Compt. rend., 254: 1611-13(Feb. 26, 1962). (In French)

The production cross section of two photons in the Compton effect depends on five parameters, and its expression is too complex for it to be used in making a general study. The investigation was limited to a numerical study from which it was determined that this phenomenon is favored for symmetric scatterings; it has a very marked directional effect, and it assumes an importance which cannot be neglected in the relativistic region. (tr-auth)

19493 MEASUREMENT OF THE WORK PER ION PAIR IN NITROGEN FOR PROTONS AND HELIUM PARTICLES IN THE ENERGY RANGE UNDER 1 Mev. L. Schaller, P. Huber, and E. Baumgartner (Universität, Basel). Helv. Phys. Acta, 34: 813-15(1961). (In German)

The mean work per ion pair is determined by $w = E/N$, where E is the energy of the incident particle and N is the number of ion pairs produced per particle in the chamber gas. The experimental set-up for the measurement of the work done in the formation of ion pairs in nitrogen by protons and helium is described. The work/ion pair for protons in the energy range from 200 to 900 kev was determined to 37.0 ev/ion pair, and it was shown to be energy independent within 1%. The value for helium was over 40 ev/ion pair with a mean error of 2 to 3 ev/ion pair. (J.S.R.)

19494 THE THEORY OF IRREVERSIBLE PROCESSES IN NEUTRAL AND IONIZED GASES. Ta-You Wu (National Research Council, Ottawa and Université, Lausanne, Switzerland). Helv. Phys. Acta, 34: 834-42(1961). (In English)

The recent theory of irreversible processes in gases developed by Prigogine and Balescu is discussed. In this theory, the distribution function $f_N(x_1, \ldots, x_N, p_1 \ldots, p_N, t)$ is expressed in a Fourier series, and the Liouville equation becomes an infinite system of equations for the Fourier components of f_N. The system is iterated to all powers of the intermolecular potential $\lambda V(|x_i - x_j|)$. By examining the asymptotic dependences of the various terms, to any given order in λ, on N, the volume and time in the limits $N \to \infty$, volume $\to \infty$, number density finite, $t \to \infty$, and by retaining

only the dominant terms, some of the Fourier components are partially decoupled from the rest and are given by a closed set of 'reduced equations'. The main contention of the theory is that, by passing to the limits above, the reduced equations will describe the irreversible approach to thermodynamical equilibrium. It is shown that, without an additional hypothesis, these reduced equations will remain invariant upon time reversal and hence will not describe irreversible processes. On the same basis and also from a more technical point of view, the work of Balescu on irreversible processes in fully ionized gases is discussed. (auth)

19495 INVESTIGATIONS OF THE MECHANISM OF THE BUBBLE FORMATION IN FREON-12 AND PROPANE BY RECOIL NUCLEI OF SOME α EMITTERS. G. Riepe and B. Hahn (Universität, Fribourg, Switzerland). Helv. Phys. Acta, 34: 865-92(1961). (In German)

The mechanism of bubble formation in superheated liquids can be described by a simple thermal model for particles whose range is smaller than the 'critical' bubble diameter. The bubble formation by recoils from α disintegrations (Po^{210}, ThC, and ThC') was investigated for CCl_2F_2 between 30 and 80°C and for C_3H_8 at 18.5°C using a temperature and pressure stabilized bubble chamber. The dependence on the degree of superheat of the bubble formation leads to the conclusion that the energy needed to form a critical-size bubble (where the evaporation term represents the main part) agrees within 5% with the recoil energy. Values obtained for the bubble formation by Auger electrons from Ar^{37} can be explained qualitatively by the same model. (auth)

19496 THERMOLUMINESCENCE OF SOLID NITROGEN AFTER ELECTRON BOMBARDMENT AT 4.2°K. Brian Brocklehurst and George C. Pimentel (Univ. of California, Berkeley). J. Chem. Phys., 36: 2040-6(Apr. 15, 1962).

Solid nitrogen annealed at 20°K and then bombarded with electrons at 4°K gives three glow peaks on warming, at 10, 14.5, and 19°K. Unannealed nitrogen gave broader peaks. A feeble, long-lived glow followed the normal afterglow after bombardment at 4°K. Thermal effects during warming were observed in one apparatus with radiation shielding at 77°K, but they were not observed in a much more sensitive apparatus with radiation shielding at 4°K. The thermal effects are probably caused by an anomalous vapor pressure and loss of Dewar vacuum. The data are discussed with reference to two interpretations, the storage of D^2 excited nitrogen atoms and the recombination of S^4 nitrogen atoms through diffusion. The latter explanation is preferred and a simple model is offered to account for the three diffusion activation enthalpies implied by the three thermoluminescence peaks. (auth)

19497 FOUR-DIMENSIONAL ELECTRON DENSITY FUNCTION. E. Bright Wilson, Jr. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 36: 2232-3(Apr. 15, 1962).

The energy, dipole moment, and many other properties of an atom or molecule can be calculated if the pair density matrix, a function of 12 variables, is available. A system is considered for calculating N electrons by four-dimensional electron density functions. The results show that the ground state energy of a system of electrons in the field of a set of fixed nuclei can be calculated if the electron density function is known sufficiently accurately, not only as a function of the spatial coordinates x, y, z but also of the parameter Z (0 to 1) which measures the scale of the nuclear charges. (N.W.R.)

19498 STRUCTURE OF f^n CONFIGURATIONS. I. CALCULATION OF THE ENERGY LEVELS. B. G. Wybourne (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 36: 2295-2300(May 1, 1962).

Calculation of the energy matrices and the construction of the energy level schemes are discussed together with the approximations that such calculations involve. Several new calculations are reported. (auth)

19499 STRUCTURE OF f^n CONFIGURATIONS. II. f^6 AND f^8 CONFIGURATIONS. B. G. Wybourne (Johns Hopkins Univ., Baltimore). J. Chem. Phys., 36: 2301-11 (May 1, 1962).

Complete energy matrices of the f^6 configuration were calculated using the methods of Racah. Energy level schemes were constructed for the trivalent samarium, dysprosium, and plutonium ions. A preliminary analysis of the observed spectra of these ions is made. (auth)

19500 ELECTROFLUORESCENCE OF RARE-EARTH-ACTIVATED Al_2O_3. I. Adams and J. W. Mellichamp (Army Signal Research and Development Lab., Fort Monmouth, N. J.). J. Chem. Phys., 36: 2456-9(May 1, 1962).

Alpha Al_2O_3 was activated with Sm^{2+}, Sm^{3+}, Eu^{3+}, Gd^{3+}, Tb^{3+}, and Dy^{3+} by mixing powders of the rare earth oxide with γ Al_2O_3 and firing in an N_2 and then in a Cl_2 atmosphere at 800 to 1000°C. When these activated powders are placed between a metal base plate and a conducting glass plate and about 500 v dc is applied, electrofluorescence is observed. The emitted spectra are characteristic of the fluorescence of the rare earth ion in the corundum structure. A mechanism for excitation is discussed. (auth)

19501 ORIENTED NUCLEI. Dezső Novak. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 158-75(1961). (In Hungarian)

The technique of oriented nuclei represents one of the most effective tools of nuclear physics; it was used for studying the conservation of parity and was found to be very valuable for investigating other fields of nuclear and solid state physics. Nuclei are considered oriented if their spins are not randomly distributed, so that the resultant of their vectors points to a definite direction. In order to avoid interferences due to thermal motion, the experiments must be carried out at temperatures ranging from 0.01 to 1°K. The methods used for orienting the nuclei include the use of externally applied magnetic fields, and intracrystalline interactions based on the hyperfine structure. Dynamic methods include that of forbidden transitions and of "optical pumping." The angular distribution of oriented γ-active materials presents an anisotropic character; the radiation possesses also a linearly and a circularly polarized component. Studies involving β-active materials resulted in the reversal of the concept of the conservation of parity and helped to clarify the theoretical basis of β-decay. The angular distribution of α-radiation contributed to the determination of the decay process and made it possible to establish the deformation of the parent nucleus. Results of previous experimental works involving oriented nuclei are tabulated. (TTT)

19502 USE OF A 200 KILOGAUSS PULSED MAGNETIC FIELD FOR MOMENTUM MEASUREMENTS OF HIGH-ENERGY PARTICLES IN NUCLEAR EMULSIONS. L. Hoffmann and J. C. Combe (CERN, Geneva). Nuclear Instr. & Methods, 15: 51-4(Feb. 1962). (In English)

Experience in the accurate measurements of momentum of high-energy particles recorded in nuclear emulsions placed in a high magnetic field is given. The field characteristics and the method of measurement, as well as the errors due to distortion and multiple scattering, give limitations on the accuracy which can be obtained. The

influence of the sources of error on the determination of the momentum and the possible corrections are discussed. In conclusion, some types of improvements which could be made are indicated. (auth)

19503 THE NONPROPORTIONAL RESPONSE OF A NaI(Tl) CRYSTAL TO DIFFRACTED X RAYS. T. H. Jones (Naval Radiological Defense Lab., San Francisco). Nuclear Instr. & Methods, 15: 55-8(Feb. 1962). (In English)

Measurements have been made of the scintillation efficiency of a NaI(Tl) crystal for diffracted x rays in the energy range from 24.7 to 46.5 kev in 1 kev increments. The maximum deviation from linearity occurred in the region from 33 to 35 kev. The nonproportional response of NaI(Tl) to electrons in the region from 0.051 to 45.426 kev was then derived using a model of the energetic electron array produced in the crystal by the incident diffracted x rays. (auth)

19504 THE LOADING OF NUCLEAR EMULSIONS WITH BISMUTH. H. G. de Carvalho and M. Muchnik (Istituto Nazionale di Fisica Nucleare, Rome and Università, Rome). Nuclear Instr. & Methods, 15: 101-2 (Feb. 1962). (In English)

A technique for loading nuclear emulsions with bismuth is described, which eliminates the usual drawbacks found with other methods. This technique has been successfully applied to the study of bismuth fission. (auth)

19505 A LIQUID AIR TRAP FOR NUCLEAR SPECTROSCOPY. S. Bashkin and T. R. Ophel (Australian National Univ., Canberra). Nuclear Instr. & Methods, 15: 12(Feb. 1962). (In English)

A liquid air trap, of relatively simple construction, which has proved effective in preventing the build-up of carbon and other contaminants on the surface of targets as a result of the cracking of pump oil vapor by particle bombardment, is described. A 0.015-in.-thick copper sleeve surrounds the target and is maintained at liquid air temperature by immersing the copper tube attached to it in liquid air. Thermal insulation is effected by a thin stainless steel section which was turned as one piece from solid rod. (auth)

19506 TOTAL ABSORPTION OF GAMMA-RAYS FROM 15 TO 27 Mev IN Be. U. Miklavžič, N. Bezič, D. Jamnik, G. Kernel, Z. Milavc, and J. Šnajder (Inst. of Jozef Stefan, Ljubljana, Yugoslavia). Nuclear Phys., 31: 570-4(Apr. 1962). (In English)

Total absorption of gamma rays from 15 to 27 Mev in Be is measured using the x-ray spectrum of a 30-Mev betatron and a Compton magnetic spectrometer. Data are presented of total photonuclear absorption, with ambiguity caused by atomic absorption. Comparison with results of measured partial cross sections shows agreement. (auth)

19507 ASYMMETRY IN DOUBLE MOTT ELECTRON SCATTERING FOR ENERGIES FROM 45 TO 245 kev. V. A Apalin, I. Ye. Kutikov, I. I. Lukashevich, L. A. Mikaelyan, G. V. Smirnov, and P. Ye. Spivak (Kurchatov Atomic Energy Inst., Academy of Sciences, Moscow). Nuclear Phys., 31: 657-63(Apr. 1962). (In English)

The asymmetry of electron scattering, in the energy region of 45 to 245 kev and at an angle of 120°, is measured using double Mott scattering on Au nuclei. (auth)

19508 NEW METHODS FOR THE DIRECT CONVERSION OF HEAT INTO ELECTRICAL ENERGY. K. G. Guenther (Siemens-Schuckert-Werke A. G., Nuremberg). Nukleonik, 4: 58-64(Feb. 1962). (In German)

Three new methods for the direct conversion of heat into electrical energy, which vary significantly from each other in operation and range of application, are described. For the range of low temperatures (T < 1000°C) the thermoelectric generator (utilization of the Seebeck effect) is used. Research installations already set up with powers of several kilowatts reach efficiencies between 5 and 6%. With a new type of semiconductor combination, it is hoped that the efficiency can be increased to 10 to 20%. With increasing temperature difficulties with the construction materials increase, especially under the effect of diffusion processes and radioinduced faults. For the highest temperature range (T > 2000°C) the MHD generator offers an economic, space-saving energy conversion. One application is to be expected for large units over 100 Mw. It is hoped that in this case the efficiency would attain approximately 60%. The difficulties in the procurement of suitable temperature-stable construction materials, however, necessitate a prolonged intensive development study for the realization of this generator. For temperatures between 1000 and 2000°C the vacuum thermoelement (thermionic converter) with a special form of the cesium iodide is especially suitable. With proven efficiencies of 15% and power densities of 20 w/cm^2 it is hoped that a commercial apparatus will be available soon. The principal problem is the development of optimum electrode materials, which would give an approximation to the theoretically possible efficiency of n = 30 to 40% at operating temperatures of 1500°C. (tr-auth)

19509 EMULSION AND BUBBLE-CHAMBER STATISTICS FOR THE DETERMINATION OF TRACK DENSITY. A. Ahmadzadeh (Univ. of California, Berkeley). Nuovo cimento (10), 24: 1-8(Apr. 1, 1962). (UCRL-9527(Rev.)). (In English)

The likelihood function (P) is given as a function of the coefficient of the exponent of the gap-length distribution function. From P the exponential coefficient is calculated and the statistical accuracy determined. It is also shown how, with a given amount of experimental data, the maximum statistical accuracy may be achieved in the determination of the track density. (auth)

19510 PERTURBATION THEORY OF SCATTERING OF A PARTICLE BY AN IDENTICAL BOUND PARTICLE. [PART] I. E. Corinaldesi (Inst. for Advanced Study, Princeton, N. J.). Nuovo cimento (10), 24: 92-102(Apr. 1, 1962). (In English)

Scattering of a particle by an identical particle in a bound state (for instance, scattering of an electron by a hydrogen atom) is treated. The treatment is based on the use of a Schroedinger equation for a two-component wave function, with a Hamiltonian that is a 2 × 2 matrix. One and only one linear combination of the components of the wave function is a solution of the ordinary Schroedinger equation for two identical particles in a field of force and interacting with each other. Such a linear combination has the symmetry required by the Pauli principle. (auth)

19511 KNIGHT SHIFT OF ^{207}Pb IN p-TYPE LEAD TELLURIDE. I. Weinberg and J. Callaway (Ford Motor Co., Newport Beach, Calif.). Nuovo cimento (10), 24: 190-2(Apr. 1, 1962). (In English)

PbTe, a p-type semiconductor of the PbS family having NaCl-type structure, is found to display a Knight shift as a result of hyperfine interactions between holes and Pb^{207} nuclei. The Knight shift $\Delta H/H$ is found to be equal to $CT^{-1/4} \exp(-E_A/2kT)$, where $C = 3.36 \times 10^{-3}$ and is independent of T, and $E_A = 0.064$ ev is the acceptor ionization potential. The implications of the results regarding the symmetries in the PbTe lattice are noted. (T.F.H.)

19512 GRADIENTS OF ELECTRIC FIELDS SET UP BY ELECTRONS AT THE SITES OF ATOMIC NUCLEI.

V. S. Korol'kov and A. G. Makhanek. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 87-91(Feb. 1962).

The gradients $q = \partial^2 V/\partial Z^2$ of electric fields set up by nonspherically symmetric atomic electrons at the nuclei of their atoms are calculated. From the quadrupole coupling constant eqQ, the quadrupole moments of the nuclei, eQ, are determined. (auth)

19513 PECULIARITIES OF THE ISOTOPIC SHIFT IN THE SAMARIUM SPECTRUM. A. R. Striganov, V. A. Katulin, and V. V. Eliseev. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 91-4(Feb. 1962).

Results of an investigation of the isotopic shift in the samarium spectrum are given. The investigation is conducted with separated isotopes. The isotopic shift is measured between components of all even-even isotopes on fifty-nine Sm I lines. An irregularity of the isotopic shift is discovered and found to be caused by variations in the deformation parameter and in the amplitude of surface vibrations of the nucleus. The relative shift for positively-displaced lines is found to differ from that for the negatively-displaced lines. This indicates that the relative isotopic shift is influenced by peculiarities of the electron shell. (auth)

19514 ON THE LUMINESCENCE OF CERTAIN SOLVENTS. K. A. Kovyrzina and I. M. Rozman. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 133-6(Feb. 1962).

The intensity of luminescence of certain solvents, excited by ionizing radiation that does not produce Vavilov-Cherenkov radiation, is measured. The lifetimes of the excited states of heptane, dioxane, and acetone are estimated from the efficiency of energy transfer. It is shown that the fraction of activated (excited and ionized) solvent molecules that attains the "fluorescent" state depends essentially on the nature of the solvent. On the basis of the experimental data, it is suggested that in scintillating solutions specific processes occurring during excitation by particles can produce a quenching of the acceptor molecules. (auth)

19515 THE EXOELECTRONIC EMISSION METHOD FOR INVESTIGATING TRAPPING LEVELS IN CRYSTAL PHOSPHORS AND ITS APPLICATION TO THE STUDY OF TRAPPING LEVELS IN CaS,SrS PHOSPHORS. V. L. Levshin and P. A. Pipinis. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 140-3(Feb. 1962).

An apparatus was designed to study the trapping levels of crystal phosphors by means of exoelectron emission in high vacuum. A substantial difference was found in phosphors of the CaS and SrS type between exoelectronic emission and glow curves: low temperature peaks did not occur on exoemission curves; high temperature peaks did not generally have corresponding peaks on glow curves. The properties of exoelectron emission curves were related to the surface nature of this emission. (auth)

19516 EXPERIMENTAL STUDY OF THE CIRCULAR DICHROISM AND OPTICAL ACTIVITY OF SODIUM URANYL ACETATE SINGLE CRYSTALS. M. S. Brodin and Ya. O. Dovgii. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 155-7(Feb. 1962).

Absorption spectra of sodium uranyl acetate single crystals were obtained at low temperatures. Seven lines were found, arranged in a characteristic fashion and exhibiting a high degree of circular dichroism. Absorption coefficient curves corresponding to several bands of crystalline origin observed at 20°K were plotted for d- and l-rotatory crystals. The data obtained concerning the spectral distribution of optical activity showed that a sodium uranyl acetate crystal rotated the plane of polarization to an appreciable extent only in the neighborhood of bands exhibiting marked circular dichroism. (auth)

19517 THE NEUTRON TUBE, A SIMPLE AND COMPACT NEUTRON SOURCE. O. Reifenschweiler and K. Nienhuis. Philips tech. Tijdschr., 23: 341-53(1961).

After a short description of the current neutron sources, a melted-off tube resembling an x-ray tube is described. This tube supplies neutrons of 14 Mev. At a supply voltage of 125 kv the output exceeds 10^8 neutrons/sec. The neutrons are made by means of a nuclear reaction between deuterium and tritium: $T(d,n)He^4$. The deuterons are produced in a Penning ion source. The catch plate consists of silver coated with titanium which contains tritium. The tube is filled with a deuterium–tritium mixture (pressure 10^{-3} torr). The duration of life of the neutron tubes amounts to more than 1000 hours. Some characteristic applications are mentioned. (auth)

19518 CALORIMETRIC MEASUREMENTS ON He^3 NEAR THE MELTING CURVE. D. O. Edwards, A. S. McWilliams, and J. G. Daunt (Ohio State Univ., Columbus). Phys. Letters, 1: 101-4(May 1, 1962).

The heat capacity of liquid and liquid-solid He^3 is measured at 0.1 to 0.6°K and 20 to 31 atm. The He^3 melting curve is found from 0.05 to 0.5°K. The data indicate that there is no phase transition in the liquid within the temperature range studied. (T.F.H.)

19519 SOLAR FLARE HELIUM IN SATELLITE MATERIALS. O. A. Schaeffer and J. Zaehringer (Max-Planck-Institut für Kernphysik, Heidelberg). Phys. Rev. Letters, 8: 389-90(May 15, 1962).

Samples of Al and Pb from Discoverer 17, which was flown during the intense solar flare of Nov. 12, 1960, are analyzed for He^3 and He^4 content. It is concluded that the He^3, and some of the He^4, found in the samples represent stopped particles from the solar burst. It is estimated that the flare particles had a He^3/He^4 ratio of 0.02. (T.F.H.)

19520 THERMAL RESISTANCE OF HOLMIUM ETHYL SULFATE. R. Orbach (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 8: 393-6(May 15, 1962).

A maximum in the thermal resistance of holmium ethyl sulfate as a function of magnetic field below 5°K is explained as resulting from the attenuation of a low-level optical phonon mode that is capable of carrying thermal currents. A second maximum is predicted in the range of acoustic modes of phonons. Data are given for fields up to 11 kgauss. (T.F.H.)

19521 SOLUTION OF THE GAP EQUATION FOR A SUPERCONDUCTOR. G. J. Culler, B. D. Fried, R. W. Huff, and J. R. Schrieffer (Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.). Phys. Rev. Letters, 8: 399-402(May 15, 1962).

A computational solution of the superconducting energy gap equation is described. A spherical band model is used for electrons that are coupled by deformation potential matrix elements to phonons having a Debye spectrum, in order to find the s-wave part of the energy gap equation; higher corrections are ignored. A graphical presentation is given, at $T = 0$, for the coupling constant as a function of the energy gap Δ; for Δ as a function of energy and coupling constant; and for the superconducting/normal density-of-states ratio as a function of energy. (T.F.H.)

19522 SUPERCONDUCTIVITY OF IRIDIUM. R. A. Hein (Naval Research Lab., Washington, D. C.), J. W.

Gibson, B. T. Matthias, T. H. Geballe, and E. Corenzwit. Phys. Rev. Letters, 8: 408-10(May 15, 1962).

Very pure Ir is found to be superconducting. The critical field varies from 16 gauss at 0.04°K to 0 gauss at 0.14°K. In the purification process, special care is taken to remove as much Fe as possible. (T.F.H.)

19523 THE OPTICAL PROPERTIES OF ALKALINE EARTH HALIDES OF THE FLUORITE TYPE. [PART] I. P. Goerlich, H. Karras, and Rita Lehmann. Phys. Status Solidi, 1: 389-440(1961). (In German)

The works which have critically considered the absorption, decoloration, and luminescent behavior of alkaline earth halides are reviewed. The absorption behavior of nondecolored crystals, absorption behavior after x, electron, and neutron irradiation, absorption behavior after electrolytic and additive decoloration, and model representation are reviewed. (J.S.R.)

19524 THE ANGULAR DISTRIBUTION OF THE CHARACTERISTIC ENERGY LOSS OF ELECTRONS, MEASURED AT 15 ev Al LOSS AND AT 17 ev Si LOSS. C. Kunz (Universität, Hamburg). Phys. Status Solidi, 1: 441-4(1961). (In German)

The angular dependence of the intensities of the 15-ev energy loss in polycrystalline aluminum layers and of the 17-ev energy loss in a single-crystal silicon layer was measured up to the cut-off angle for an incident electron energy of 39 kev. The angular intensity distribution in the vicinity of the forward direction was measured with Al for different incident electron energies. The results obtained for Si are in good agreement with theory, while for Al small discrepancies occur in the vicinity of the forward direction. (auth)

19525 THE QUANTUM THEORY OF TRANSVERSE ACOUSTIC OSCILLATIONS IN THE PLASMA MODEL FOR METALS. Hubertus Stolz (Physikalisch-Technisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 1: 451-5(1961). (In German)

If one ascribes artificially an elastic shear-modulus to a degenerate electron-ion plasma, a theory of transverse acoustic waves can be formulated, which is an adequate model for the description of the absorption and dispersion of acoustic shear waves in metals. The special features of this method are its close analogy to the plasma theory of longitudinal waves and its applicability to the case of an external magnetic field. (auth)

19526 THE MODIFICATION OF THE OPTICAL ABSORPTION SPECTRUM OF SILVER BROMIDE CRYSTALS BY DISSOLVED DIVALENT IMPURITIES. G. Scheidler (Institut für Kristallphysik der Deutschen Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 1: 459-68(1961). (In German)

If divalent cation impurities are incorporated in AgBr crystals containing divalent anion impurities, an optical absorption is found close to the intrinsic absorption edge, consisting, at a temperature of –170°C, of several bands. The characteristic behavior of this absorption is partly opposite to that of crystals containing only cation impurities. Conclusions are drawn as to the structure of the absorption centers. (auth)

19527 THE PHOTOCHEMICAL BEHAVIOR OF ILLUMINATED AgBr CRYSTALS WITH DIVALENT IMPURITIES. G. Scheidler (Institut für Kristallphysik der Deutschen Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 1: 469-82(1961). (In German)

Continuing an earlier paper, the photochemical behavior of oxygen-sensitized AgBr crystals is investigated. Colloidal silver is formed by illumination at 20°C. On illumination below –120°C an absorption spectrum is built up consisting of a system of bands, with maxima at 560 and 660 mμ, lying on a strong background. Absorption measurements were also carried out with illuminated AgBr crystals containing both divalent anion and divalent cation impurities. These crystals can be colored only by illuminating at high temperatures. The impurities giving rise to an additional absorption in non-illuminated crystals are shown not to contribute directly to certain photochemical absorption bands. An interpretation is given on the basis of simple models. (auth)

19528 THE OPTICAL PROPERTIES OF ALKALINE EARTH HALIDES OF THE FLUORITE TYPE. [PART] II. P. Goerlich, H. Karras, and Rita Lehmann. Phys. Status Solidi, 1: 525-53(1961). (In German)

In the concluding part of the review article of alkaline earth halides, luminescence, activated CaF_2 crystals, thermoluminescence, and applications are discussed. 65 references. (J.S.R.)

19529 THE FORMATION OF ANION VACANCIES IN IMPURITY-ACTIVATED KBr CRYSTALS BY X IRRADIATION. H. Bauser and F. Luety (Technische Hochschule, Stuttgart). Phys. Status Solidi, 1: 608-18(1961). (In German)

This paper deals with the role of impurity ions in the x-ray production of anion vacancies at low temperatures. In the first part, the production and thermal stability of anion vacancies in x-irradiated KBr crystals are compared with photochemical processes in crystals containing hydride ions. It is suggested that the ejection of anions from their lattice sites during x irradiation may result from a process analogous to the optical U–α conversion. In order to test this hypothesis, in the second part the production of α and F centers in KCl-doped KBr crystals is investigated at 90°K. The initial rate of α center formation depends in a characteristic way on the ratio of the halide components in the mixed crystals. The rate of F center production, however, is not influenced appreciably by the presence of Cl ions. This effect is interpreted in terms of the preceding consideration. Some observations on the positions of α and β absorption peaks in mixed crystals are appended. (auth)

19530 SPACE-CHARGE EXPANSION OF A POSITIVE HYDROGEN ION BEAM LEAVING A DUOPLASMATRON ION SOURCE. A. B. Wittkower, A. Galejs, P. H. Rose, and R. P. Bastide (High Voltage Engineering Corp., Burlington, Mass.). Rev. Sci. Inst., 33: 515-20(May 1962).

Space-charge is shown to be the controlling influence in the expansion of a positive hydrogen ion beam leaving a duoplasmatron source aperture. This implies that there is an optimum source aperture radius for each application. In particular, when high currents are required, this aperture may be large, i.e., greater than 0.05 in. radius. The gas flow from the source into the vacuum system may then become excessive; an extraction system which allows the aperture radius to be increased without this attendant gas flow is described. (auth)

19531 OBSERVATION OF THE FOCUSED RING OF CERENKOV LIGHT FROM A SINGLE PARTICLE. S. K. Poultney, G. T. Reynolds, and J. R. Waters (Princeton Univ., N. J.). Rev. Sci. Instr., 33: 574-5(May 1962). (PPAD-451 E)

An image intensifier system was used to observe the focused ring of Cherenkov light emitted by a single particle. (L.T.W.)

19532 GEOMETRY OF CHARGED PARTICLE MOTION IN A STATICAL MAGNETIC FIELD. Yu P. Pyt'ev. Vestnik Moskov. Univ., Ser. III, No. 6, 47-61(1961). (In Russian)

The geometry of charged particles in motion in a magnetic field is analyzed and trajectory equations are developed. (R.V.J.)

19533 THE HEAT CONDUCTIVITY OF GASEOUS PARA-ORTHO HYDROGEN MIXTURES AT 20°K. K. Heinzinger, A. Klemm, and L. Waldmann (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 16a: 1338-42(Dec. 1961). (In German)

With a differential method, the relative differences of the heat conductivity of para-hydrogen and various mixtures of para- and ortho-hydrogen were measured at 20°K. It was shown that the para-hydrogen possesses a heat conductivity about (5.84 ± 0.30)% greater than normal hydrogen and that the heat conductivity of the mixtures has negative second derivatives as a function of the ortho-hydrogen concentration. The results agree with corresponding viscosity measurements by Becker and Stehl and as yet give no complete theoretical interpretation. (tr-auth)

19534 CAPACITY PATTERN AND ELECTROPHOTOLUMINESCENCE OF AN OPTICALLY EXCITED ZnCdS PHOSPHOR IN A CONSTANT ELECTRIC FIELD. F. Matossi, H. Gutjahr, and D. Siebert (Fraunhofer-Gesellschaft e. V. and Universität, Freiburg i. B.). Z. Naturforsch., 16a: 1391-3(Dec. 1961). (In German)

For an accurate discussion of the light flash in optically excited ZnCdS phosphors during the switching on and off of electrical fields, it is necessary to know the transient variation of the electron concentration within the crystal during the light flash. The measurement of the capacity pattern under the effect of electrical fields is suitable for the determination of the variation of the electron concentration in powdered phosphors. The capacity variation was recorded by oscillograph at a frequency of 30 kHz with a resolution of 1 msec and it was compared with the electrophotoluminescence curve. The results are shown graphically and indicate that the momentary glow of phosphors during the switching on and off of an electrical field can not be explained by an increase of the electron concentration within the crystal by excitation of electrons from bond sites in the conduction band. (J.S.R.)

19535 ON THE TRAPPING OF MAGNETIC FLUX BY SUPERCONDUCTING TOROIDS. Gerhart Lueders (Universität, Göttingen, Ger.). Z. Naturforsch., 17a: 181-2(Feb. 1962). (In English)

When a doubly connected piece of superconducting material is cooled down below the transition temperature in the presence of an external magnetic field, a magnetic flux is trapped. The trapped flux is an integral multiple $\phi = n\phi_0$ of the quantity $\phi_0 = hc/2e$. The manner in which the "fluxoid quantum number" n might be determined by the external magnetic field is discussed. (J.S.R.)

19536 QUANTIZATION OF THE MAGNETIC FLUX IN SUPERCONDUCTING CYLINDERS. Wolfgang Weller (Universität, Leipzig). Z. Naturforsch., 17a: 182-3 (Feb. 1962). (In German)

The quantization of magnetic flux in a superconducting hollow cylinder was discussed within the framework of the phenomenological theory of Ginsburg and Landau. (tr-auth)

19537 THE INTERACTION OF TWO HELIUM ATOMS. D. Y. Kim (Technische Hochschule, Aachen). Z. Physik, 166: 359-69(1962). (In German)

The interaction energy between two helium atoms in the ground state is calculated by a variational principle. Besides the valence energy $387 \times \exp(-4.42\ R)$ (R in Å, energy in ev) and the van der Waals energy $-0.58/R^{5,9}$ an additional energy term $366 \times \exp(-7.15\ R)$ is obtained which is particularly important for $R \approx 3$ Å. A potential minimum but no equilibrium exists because the zero point energy is too large. The results of other authors are discussed and compared. (auth)

19538 EFFECTIVE COLLISION CROSS SECTIONS IN SCATTERING RESEARCH. K. Berkling, R. Helbing, K. Kramer, H. Pauly, Ch. Schlier, and P. Toschek (Universität, Bonn). Z. Physik, 166: 406-28(1962). (In German)

Scattering experiments are often not performed with the ideal set-up consisting of a monochromatic beam and target particles at rest. This is, for instance, never the case in molecular beam scattering, which is of primary interest in this paper. Two arrangements are normally employed, one consisting of a gas chamber as target, the other of a crossed beam, generally at right angles to the incoming beam. In both cases the scattering particles have a Maxwellian velocity distribution. This means that in any such experiment an "effective cross section" is measured, which is an integral over cross sections for different collision velocities. Other similar integrals are needed, if one works with polarized beams and takes into account the fact that the cross section is angular dependent. A third type of integral is required, when the primary beam is not monochromatized, and one has to average over its velocity distribution too. The functions needed to interpret scattering experiments of all the types mentioned are given, as well as a table of values for the 24 most important of these functions. (auth)

19539 INVESTIGATION OF THE LUMINESCENCE DECAY OF TUNGSTEN PHOSPHORS AFTER EXCITATION WITH UV LIGHT AND ELECTRONS. Volker Schaefer (Universität, Giessen, Ger.). Z. Physik, 166: 429-38(1962). (In German)

The decay of the luminescence of $CaWO_4$, $CdWO_4$, $MgWO_4$, and $ZnWO_4$ after excitation with short pulses of light and electron beams was investigated at different temperatures. Excitation with UV light yields an exponential decay, and from the temperature dependence of the decay time it can be concluded that at high temperatures nonradiative transitions are prevalent. After excitation with electrons, there are additional effects by the heating up of the "excitation channel." In this case the decay is not purely exponential and thermoluminescence is observed. This indicates the existence of traps, which are assumed to be located in the centers of the luminescence. (auth)

19540 ELECTROLUMINESCENCE OF ZINC SULFIDE SINGLE CRYSTALS. Frank Matossi and Guenter Schmid (Universität and Fraunhofer-Gesellschaft, Freiburg i. B.). Z. Physik, 166: 455-9(1962). (In German)

Brightness waves observed at the anode of ZnS crystals on excitation with a-c voltage, with and without superimposed d-c voltage, show "green" maxima (5200 Å) at phases related to the phases of zero voltage or current. They disappear if the electrodes are isolated from the crystal. The observations can be interpreted by assuming hole injection as the cause of the electroluminescence and taking into account a decrease of recombination probability with increasing velocity of the charge carriers. At high voltages, a "blue" maximum (4770 Å) appears in phase with voltage maximum, and this over the whole crystal. (auth)

19541 THE ISOTOPE SHIFT IN THE SILVER I AND II SPECTRUM. Matthias Elbel and Wolfgang Fischer (Universität, Marburg, Ger.). Z. Physik, 166: 504-9(1962). (In German)

By use of electromagnetically separated isotopes, the isotopic shifts of the transition between the configurations $4d^{10}5p-4d^{10}6s$, 7s, 5d, and 6d in the Ag I spectrum and between the configurations $4d^{9}6s-4d^{9}6p$ and $4d^{9}5p-4d^{8}5s^{2}$ in the Ag II spectrum were investigated. Within the measurement accuracy obtainable, no coupling effect could be found. For the isotopic shift constant, the value 34 mk was found. (tr-auth)

19542 AN INVERSE OPPOSING FIELD METHOD FOR THE ENERGY ANALYSIS OF ELECTRON AND ION BEAMS. H. Boersch and S. Schweda (Technische Universität, Berlin). Z. Physik, 167: 1-10(1962). (In German)

The inverse opposing field method depends on the measurement of the charge carrier beam reflected by an opposing field and permits the measurement of integral energy distributions. Its advantage with respect to the usual opposing field methods consists in the low sensitivity for accidental current oscillations in the region of interest and the avoidance of currents from secondary electrons in the measurement of the energy distribution of ion beams. The application possibilities of the inverse opposing field method is shown on the measurement of the energy distribution of thermally released electrons and Li^{+} ion beams and the measurement of discrete energy losses of electrons and Li^{+} ion beams after their passage through He gas. (tr-auth)

19543 ON THE LUMINESCENCE OF TlCl + KCl PHOSPHOR. S. C. Sen and H. N. Bose (Indian Inst. of Tech., Kharagpur). Z. Physik, 167: 20-5(1962). (In English)

The measurements on the luminescence spectra of TlCl + KCl mixed phosphors under low-energy cathode rays at 80°K are presented. The reflectance as well as excitation spectra of this mixed phosphor were also studied. The x-ray-diffraction studies of the samples along with the optical studies show that the mixed phosphor consists of two phases: (1) KCl:Tl and (2) TlCl:K. It was observed that the emission bands due to the thallous chloride are gradually quenched with the increase in potassium chloride content of the phosphor; further, the emission bands supposed to be due to KCl:Tl phosphors gradually appear. Since some of the emission bands obtained with KCl:Tl phosphors at high thallium content are also present in the luminescence spectra of thallous chloride, it is suggested that such bands should be attributed to undissociated thallous chloride present in KCl:Tl phosphor. The quenching of thallous chloride emission by the incorportion of potassium chloride in the system was explained as being due to the absence of stoichiometric excess of thallium in such a mixed system. The results also show that the absorption spectra of the mixed system is determined by the minor components KCl:Tl. This indicates that the absorption spectra of KCl:Tl phosphor should not be affected by the presence of undissociated thallous chloride. (auth)

19544 THE SIGN OF THE HYPERFINE STRUCTURE SPLITTING OF THE $3d^{5}\ 4s^{2}\ {}^{6}S_{5/2}$ GROUND STATE OF Mn^{55}. L. Goodman, G. Noeldeke, and H. Walther (Universität, Heidelberg). Z. Physik, 167: 26-8(1962). (In German)

Using a double Fabry-Perot interferometer and an atomic-beam light source, the sign of the hyperfine-structure splitting of the $3d^{5}\ 4s^{2}\ {}^{6}S_{5/2}$ ground state of Mn^{55} was determined to be negative. The absolute value of the splitting previously was measured by Woodgate and Martin. (Proc. Phys. Soc., London A70: 485(1957)). (auth)

19545 THE ANGULAR DEPENDENCE OF THE CHARACTERISTIC ENERGY LOSSES IN Al, Si, Ag. Christof Kunz (Universität, Hamburg). Z. Physik, 167: 53-71(1962). (In German)

The angular dependence of the amount of the energy losses, of the width of the loss peaks, and of their intensities was measured, and general agreement with the plasma theory is found for the 15-ev Al loss and the 17-ev Si loss. In addition, there is a remarkable dependence of the width of the Al loss peaks on the mean crystalline size. The intensities of the 3.6-ev Ag loss and the 6 ev Al loss show a more rapid decrease with scattering angle than is required by ordinary plasma theory. The variation of the intensities of these losses with foil thickness was investigated and gives evidence that both of these losses must be due to surface excitation. (auth)

19546 ANALYTICAL DETERMINATION OF CHARGED PARTICLE PATH IN PLANE ELECTROSTATICAL FIELDS. E. S. Kochanov. Zhur. Tekh. Fiz., 32: 294-302(Mar. 1962). (In Russian)

A differential equation (with a coefficient expressed as γ functions) was derived for charged particle trajectories in a plane electrostatic field. The symmetric plane electrode system and a new method for finding trajectories are analyzed, and the advantages of the new method over the differential trajectory equations using physical field potential are demonstrated. (tr-auth)

19547 DISCHARGE CAUSED BY THE TRAVELLING ELECTROMAGNETIC WAVE. R. A. Demirkhanov, Yu. S. Khodyrev, N. D. Romashko, and B. T. Nadykto. Zhur. Tekh. Fiz., 32: 313-21(Mar. 1962). (In Russian)

A slightly ionized electrodeless discharge, excited by a moving electromagnetic wave from a spiral waveguide in a toroidal discharge tube, was studied under conditions in which the discharge appears as an unspiraled coil. It is shown that a considerable positive spatial potential develops in relation to the walls of the chamber and the electron distribution along the radius is not that anticipated from positive column theory. The discharge properties are explained by a nondiffusing mechanism of electron escape to the walls and by a focusing effect of the electromagnetic wave. (tr-auth)

19548 SOME PROCESSES OF IONIZATION OF HEAVY ATOMS AND IONS. L. G. Filippenko (Kiev Inst. of Physics, Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 32: 356-9(Mar. 1962). (In Russian)

Formulas for ionization cross sections, developed by O. B. Firsov (Zhur. Eksptl'. Teoret. Fiz., 36: 1517(1957)), were verified, and it is shown that an ionization process with low-charge ion capture is not very probable. (tr-auth)

19549 SPARK CHANNEL BREAKAGE APPEARING AT HIGH FREQUENCY REPEATING DISCHARGES. M. P. Vanyukov, V. I. Isaenko, and G. N. Travleev. Zhur. Tekh. Fiz., 32: 373-4(Mar. 1962). (In Russian)

A spark channel in xenon at discharge frequencies of 3000 to 4000 Hertz was photographed, in order to determine the irregularities in the spark intervals. (R.V.J.)

19550 PROSTRANSTVENNYE NESTATSIONARNYE DVIZHENIYA SPLOSHNOI SREDY S UDARNYMI VOLNAMI. (Spatial Non-Stationary Motion of Solid Medium with Shock Waves). A. G. Bagdoev. Erevan, Publishing House of the Academy of Sciences, Armenian SSR, 1961. 275p.

Nonstationary motion of a solid medium in a semi-space induced by shock waves and solid body penetration is analyzed. The linear and nonlinear motion of a solid medium in compressible liquid or elastic solids are also studied. 65 references are included. (R.V.J.)

19551 METHODS OF EXPERIMENTAL PHYSICS. VOLUME 3. MOLECULAR PHYSICS. Dudley Williams, ed. New York, Academic Press, 1962. 772p.

Molecular spectroscopy methods are reviewed, with particular attention to microwave, infrared, electronic, and Raman spectra. Diffraction techniques and theory are investigated, with emphasis on x-ray, electron, and neutron diffraction. Nuclear magnetic resonance, electron spin resonance, and nuclear quadrupole resonance studies are described. Applications of mass-spectrometric methods to molecular studies are discussed. The theory, optics, and resonance and spectroscopic methods for molecular beams are outlined. The electric properties of molecules (e.g., electric polarization) and the velocity and absorption of sound in gases, vapors, and liquids are studied. Guides for evaluation and statistical analysis of data are presented. (T.F.H.)

19552 IONIZATION PHENOMENA IN GASES. Proceedings of the Fifth International Conference, Munich, 28 August–1 September 1961. Volume I. H. Maecker, ed. Series in Physics. Amsterdam, North-Holland Publishing Company, 1962. 1149p.

One hundred thirty papers are included; separate abstracts have been prepared for 88. Two papers were previously abstracted in NSA. Of the 88 papers abstracted separately, 72 are in English, 7 in French, and 9 in German. The articles not abstracted separately cover such topics as vacuum ultraviolet radiation; avalanche pulses and detection; breakdown mechanisms, processes in several geometries and gases, inducement by microwaves, and behavior in the presence of spark-produced chemicals; pulsed and steady arcs in various gases, arc currents and arc reignition behavior; glow discharges; cold-cathode discharges; spectra and brightness temperatures; shock waves from very high-frequency pulses and spectra behind shock waves; the theory of luminous discharges in cylindrical geometries; adsorption of Au atoms on Mo; ion mobilities in and thermal conductivities of gases; temperatures in a flame–high-frequency-torch system; ion extraction from discharges; electron removal in afterglows; G-factors in gases; discharges in mixed gases; and general properties of discharges (cathode spots, positive columns, anode and cathode fall, glow regions, and dark spaces) and the phenomena giving rise to these properties. (T.F.H.)

19553 THE RADIATIVE FORMATION AND DESTRUCTION OF NEGATIVE IONS. Lewis M. Branscomb (National Bureau of Standards, Washington, D. C.). p.1-18 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The formation and destruction of negative ions by radiative processes are reviewed. Photodetachment spectra of H^-, O^-, S^-, and C^- are studied experimentally in crossed beams. Agreement between theory and experiment on H^- is obtained except in the threshold region, where the theoretical values are about 10% low, presumably because of neglect by the theory of polarization effects. The C^- spectrum is consistent with that expected for a ^4S ground state about 1.25 ev below the continuum, and a weakly bound metastable (presumably ^2D) state that gives rise to a weak absorption on the infrared side of the 1.25-ev threshold. Metastable states of other atomic ions are predicted. Radiative attachment cross sections and rate coefficients are discsused. The difficulties in interpretation of molecular photodetachment spectra are noted. (auth)

19554 CHARGE CHANGING COLLISIONS. J. B. Hasted (University Coll., London). p.19-24 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Charge exchange processes for singly and multiply charged ions are measured and compared with quantum theory calculations, with a refined version of the adiabatic theory, and with a formulation of the theory of pseudo-crossing potential energy curves. (auth)

19555 ASTON BANDS IN ATMOSPHERIC GASES. L. Kerwin and William McGowan (Université Laval, Quebec). p.33-41 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Aston bands resulting from dissociation and charge-exchange collision reactions in argon, nitrogen, and oxygen are reported. In some cases enriched isotopes are used to separate bands. Some reaction cross sections are given, as well as evidence for relatively large contributions to the cross sections by excited and metastable ions. (auth)

19556 THE FORMATION AND STABILITY OF MOLECULAR IONS. Robert N. Varney (Washington Univ., St. Louis). p.42-6 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Studies are reported on molecular ions in nitrogen, hydrogen, and argon, namely N_4^+, H_3^+, and Ar_2^+. A statistical mechanical analysis exists predicting the range of stability of these ions as a function of pressure and E/p_0. The results on N_4^+ indicate that the molecule must be in strong vibrational excitation. In H_3^+, a charge exchange with H_2 seems to occur in which a proton rather than an electron is exchanged. In A_2^+, the surprising stability of the molecule is investigated and is attributed to a failure of favorable types of collisions to occur rather than to a high intrinsic stability of the molecule. (auth)

19557 REARRANGEMENT COLLISIONS: PROTON–HYDROGEN SCATTERING. Marvin H. Mittleman (Univ. of California, Livermore). p.47-53 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (UCRL-6368-T). (In English)

Scattering theory is applied to the problem of the scattering of protons by hydrogen. An expression is given for the transition matrix for rearrangement scattering that eliminates the difficulties arising from the lack of orthogonality of the initial and final states. A modification of the method of closely coupled states is presented. This is accomplished via the optical-potential method. It yields a set of coupled equations which in principle are exact. When approximations are made, the usual method of closely coupled states appears as the lowest approximation. The next order produces the correct long range interactions. (auth)

19558 INTERACTION OF Li^+ IONS WITH H_2 AND He IN THE ENERGY RANGE OF 5 TO 25 kev. J. Van Eck, F. J. De Heer, and J. Kistemaker (F.O.M. Laboratorium voor Massascheiding, Amsterdam). p.54-9 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The interaction of Li^+ ions with H_2 and He is investigated at 5 to 25 kev. Cross sections are determined for electron capture, ionization, and electron loss in these gases. Moreover, the excitation of several He and H_2 spectral lines is studied. (auth)

19559 THE IONIZATION BY H^+ IONS IN THE ENERGY RANGE 0.15–1.1 Mev. E. W. McDaniel, J. W. Hooper, D. W. Martin, and D. S. Harmer (Georgia Inst. of Tech., Atlanta). p.60–8 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The measurement of the gross cross section for ionization of He, Ne, Ar, H_2, N_2, CO, and O_2 by fast protons is described. The projectile ions are obtained from a Van de Graaff accelerator, and their energy is varied from 0.15 to 1.1 Mev. Target gas pressures and collision chamber dimensions are chosen so that "thin target" conditions prevail, i.e., multiple reactions occur to a negligible extent. Thus the cross sections presented pertain to ionization produced only by the incident primary beam. (auth)

19560 EXCITATION CROSS-SECTIONS FOR HIGHLY IONIZED ATOMS. C. M. Varsavsky (Universidad, Buenos Aires). p.69–74 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The Coulomb-Born approximation is applied to the computation of the cross section for excitation of the resonant lines of O^{6+} by electron impact. Only partial waves with $e = 0$, 1, and 2 are considered. The results indicate that, while for energies near threshold contributions of $e > 2$ are negligible, this is not true for higher energies of the incoming electron. The results are compared with those of other approximations. (auth)

19561 IONIZATION COEFFICIENTS FOR HYDROGEN IN CROSSED ELECTRIC AND MAGNETIC FIELDS. S. C. Haydon and A. G. Robertson (Univ. of New England, Armidale, New South Wales, Australia). p.75–84 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Experimental and analytical procedures for the evaluation of pre-breakdown ionization coefficients (α) in hydrogen are examined, with application to problems arising in the presence of uniform crossed electric and magnetic fields. The conditions necessary to obtain reliable values of α/p_0 from information about the growth of ionization with increasing gas pressure are established. Values are presented for α/p_0 and the sparking potential V_S in crossed fields between plane-parallel electrodes in the range of E/p_0 up to 250 V × cm^{-1} × (mm Hg)$^{-1}$ and of H/p_0 up to 400 gauss × (mm Hg)$^{-1}$. (auth)

19562 A THEORY OF HIGH-ENERGY SPUTTERING BASED ON FOCUSED COLLISION SEQUENCES. M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.85–95 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Sputtering from monocrystals along simple crystal axes is invoked as evidence for focused sequences of atomic collisions traveling back to the surface from the initial ion-atom collision. A theory of sputtering is developed on this basis, which predicts that the sputtering ratio as a function of energy (E) should rise to a broad maximum, followed by a decrease approximately as 1/E. The calculations are in quantitative accord with light ion sputtering experiments, but are only capable of qualitative predictions for heavy ions. The observed cosine law of sputtering from polycrystalline targets is accounted for. (auth)

19563 CURRENT DEPENDENCE OF SPUTTERING IN GLOW DISCHARGE. K. Takatsu and T. Toda (Electrical Communication Lab., Tokyo). p.96–105 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The sputtering rate W in glow discharge was measured as the function of discharge current I. The measurement was performed by detecting the (weight-sensitive) frequency change of a quartz oscillator. The approximate relation $W \propto I^3$ was obtained and this relation was explained by combining momentum transfer theory and cathode fall theory, considering the cathode fall and the cathode temperature as a function of discharge current. (auth)

19564 THE SPUTTERING OF SILICON CARBIDE BY POSITIVE ION BOMBARDMENT. Richard E. Honig (RCA Labs., Princeton, N. J.). p.106–17 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A high-intensity ion source, based on an oscillating electron beam operating at low gas pressures, is used in conjunction with a mass spectrometer to study the sputtering process. A silicon carbide surface bombarded by rare gas ions of moderate energy is found to emit complex patterns of neutral particles and positive and negative ions. Relative yields are obtained as a function of primary mass and energy. The results are in satisfactory agreement with sputtering theory. (auth)

19565 LOW ENERGY SPUTTERING OF ALKALI HALIDE CRYSTALS. R. P. Stein (Lockheed Aircraft Corp., Palo Alto, Calif.). p.118–23 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The results of a study of the angular distributions of sputtered particles (principally potassium atoms) resulting from the bombardment of a potassium chloride crystal by neutral argon and neon atoms at 400 ev is described. Some observed distributions are presented and a discussion of their possible interpretation is given. The sensitivity of the observed results to surface conditions and neutral beam intensities is pointed out. (auth)

19566 CATHODE SPUTTERING BY RARE GAS IONS OF LOW ENERGY. C. H. Weijsenfeld and A. Hoogendoorn (Universiteit, Utrecht). p.124–30 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Single crystals of Cu are bombarded with Ne^+, Ar^+, Kr^+, and Xe^+ ions. The directional distributions of atoms sputtered from (100) and (111) surfaces bombarded with normally incident ions are determined. For a (100) surface the preferential sputtering in the [100] direction increases with the ion energy and decreases with the ion mass. The sputtering yield is determined of polycrystalline spheres of Cu, Ni, Fe, and Mo, bombarded with normally incident Ne^+, Ar^+, Kr^+, and Xe^+ ions with energies from 100 to 1000 ev. From the experiments it is obvious that the order of succession of different ion species according to increasing sputtering yield depends on the ion energy. (auth)

19567 PHOTONS AND METASTABLE ATOMS PRODUCED IN SPUTTERING EXPERIMENTS (5–20 kev). J. M. Fluit, L. Friedman, J. van Eck, C. Snoek, and J. Kistemaker (F.O.M. Laboratorium voor Massascheiding, Amsterdam). p.131–49 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A study was made of the production of excited atoms sputtered from Cu polycrystalline and monocrystalline targets. Metastable atoms from the target were measured with a secondary electron emission detector; the light from the target was measured with a grating spectrometer (range 2000 to 6000 Å). The targets were bombarded by Ne^+, Ar^+, and Cu^+ ions, mainly at an energy of 15 kev. It was found by application of pulsed ion beams

on the target that the energy distribution of sputtered metastable atoms had a maximum of about 11 ev corresponding to a velocity of about 10^6 cm/sec for Cu metastables. This showed that certainly no reflection of fast ions or atoms from the primary beam nor any photons produced the secondary electrons found with the metastable detector. Moreover, the fact that metastables could be detected from Cu targets bombarded with Cu^+ ions showed that the $^4F_{\frac{9}{2}}$ metastable level of Cu at 5.0 ev was responsible for 3% metastables among the total number of sputtered Cu atoms. The total yield of photons from Cu targets was 7×10^{-5} per sputtered Cu atom. Most of these photons were from the Cu I spectrum resonance lines at 3247 and 3274 Å. The Cu I, Cu II, Ar II, and Ne II spectra were detected with 15 kev Ar^+ and Ne^+ ions. A large influence of the angle of incidence in the number of metastables and photons produced is found. This shows that normal sputtering of neutral Cu atoms takes a place deeper inside the crystal than the sputtering of excited atoms. A change in the orientation of the monocrystal with respect to the beam produces an angular dependence analogous to that for normal sputtering. A comparison with the theory for the de-excitation of excited atoms in the potential field of a metal surface showed that the number of observed metastables was probably rather high. This might be caused by crystal damage or changes in the surface potential by bombardment of the 15-kev ions. It was thought that the excited atoms originated from the crystal itself and were not created in the gaseous phase by ion or electron impact. (auth)

19568 POSITIVE ION EMISSION FROM METAL SURFACES. R. Bradley and E. Ruedl (Cornell Univ., Ithaca, N. Y.). p.150-60 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Studies using a mass spectrometer of the emission of positive ions from metal surfaces are discussed. Analyses of thermionic emission of impurities gives quantitative information concerning diffusion through and desorption from samples of copper and platinum. Similarities and differences between secondary ions (that is, ions released by ion bombardment) and sputtered particles are discussed, and some observations made regarding the efficacy of sputtering as a method of cleaning surfaces. Evidence in support of the hypothesis that reflected gaseous ions are sputtered from surface layers rather than reflected is presented. (auth)

19569 MOLECULAR EXCITATION OF HYDROGEN AND NITROGEN FROM ELECTRON SWARM EXPERIMENTS. L. S. Frost and A. V. Phelps (Westinghouse Electric Corp., Pittsburgh). p.192-202 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The energy distribution function of electrons in hydrogen and nitrogen at 77 and 300°K is computed at values of the applied electric-field-to-pressure ratio such that rotational excitation is the dominant energy loss process. The discrete nature of the energy loss occurring in a rotational excitation collision is included in the theory, as are collisions of the second kind with thermally excited molecules. The resulting values of drift velocity and characteristic energy are compared with the available experimental data, and adjustments made in the assumed curves of momentum transfer and rotational excitation cross section to improve the agreement. Curves are given of momentum transfer cross section vs energy in both gases, which yield good agreement between theory and experiment, and conclusions are reached concerning the magnitude of the rotational excitation cross sections. (auth)

19570 ATOMIC ION PRODUCTION IN RADIO-FREQUENCY ION SOURCES. C. C. Goodyear and A. Von Engel (Clarendon Lab., Oxford). p.203-13 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

An examination of the collision processes in the electrodeless discharge of a hydrogen ion source, shows that the high yield of atomic ions occurs by a two-stage process of dissociation of the molecules and ionization of the atoms. A theoretical study of the balance between production and loss of atoms, together with measured values of plasma density and electron temperature, predicts a high degree of dissociation for a certain range of pressure. The energy balance is also examined and shows that most of the power maintaining the discharge is used in producing ultraviolet quanta from excited atoms. (auth)

19571 THE EFFECT OF IONIZATION AND RECOMBINATION ON THE ELECTRON DISTRIBUTION FUNCTION OF A SLIGHTLY IONIZED GAS WITH PRESENCE OF ELECTRIC AND MAGNETIC FIELDS. Ching-Sheng Wu (California Inst. of Tech., Pasadena). p.214-22 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The effect of ionization and recombination on electron distribution function of a slightly ionized gas is discussed for general values of the free-life time. Account is taken of the presence of external magnetic and electric fields. The general expressions of electron drift velocity and mean energy are obtained by assuming that the electron collision frequency is independent of the electron velocity. The postulation is supposed to be valid for electrons of low energy. (auth)

19572 THE WEAK-FIELD LORENTZ GAS AND A PERTURBATION THEORY OF APPROXIMATE SOLUTION TO THE BOLTZMANN EQUATION. W. A. Janos (Raytheon Co., Wayland, Mass.). p.223-34 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The Lorentz-gas model of the Boltzmann equation is solved in closed form for conditions approximating weak external field effects. General methods of perturbation theory are devised to obtain bounds for the validity of the approximation, in terms related to errors in derived expectation values caused by the use of the approximate distribution function. The zero field solution is derived exactly in closed form and serves in a modified and specific manner as the weak field approximation. The weak field solution is shown to portray on the average the property of decay to equilibrium expected for a perturbation of the zero field distribution function. Quantitative upper bounds are established on the field magnitudes in terms of number density of neutral atomic scatterers, and time duration for weak field effects. (auth)

19573 THE SPACE CHARGE SHEATH IN LOW PRESSURE ARCS. P. L. Auer (Euratom-CNEN, Frascati, Italy). p.297-305 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

It is shown that conditions leading to the establishment of a space-charge sheath in the positive column of low-pressure arcs provide for a minimal requirement in the positive ion current delivered to the sheath. The minimum required current for a given ion is a function of only the electron density and temperature, and is independent of the specific mechanism of ion production for the special case of a plane symmetric discharge. These conclusions are used to shed light on the Bohm criterion. (auth)

19574 ABSORPTION OF PHOTONS IN A TOWNSEND DISCHARGE. M. S. Bhalla, J. D. Craggs, and J. M. Meek (Univ. of Liverpool). p.315-23 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Two adjacent uniform field gaps were used to measure the absorption of photons produced in a Townsend discharge. Photons produced in one gap passed through a common mesh anode and fell on the cathode of the other gap in which the absorption of photons was measured. Experiments were carried out in hydrogen, water vapor, carbon monoxide, carbon dioxide, and air. (auth)

19575 CYLINDRICAL PLASMA IN A LONGITUDINAL MAGNETIC FIELD. Kenzo Yamamoto, Shigeki Miyajima, and Satoshi Ito (Nagoya Univ., Japan). p.324-32 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A plasma cylinder in a longitudinal magnetic field is considered at very low pressure. Neglecting collision terms in the equations of momentum perpendicular to the magnetic field and assuming that the ionization is spatially constant, a determination is made of the radial distributions of several quantities (e.g., the "ambipolar electric potential" and the flow speed of ions). From the results the functional dependence of T_e on $P_a \cdot R_w$ can be found, where T_e is the electron temperature, P_a the pressure of atoms, and R_w the tube radius. It is theoretically shown that the plasma cylinder in the longitudinal magnetic field is not stable under certain conditions. (auth)

19576 ELECTROSTATIC POTENTIAL GRADIENTS IN A NONTHERMAL PLASMA. R. G. Meyerand, Jr., F. Salz, E. C. Lary, and A. P. Walch (United Aircraft Corp., East Hartford, Conn.). p.333-42 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

It is shown that electrostatic potential gradients may exist in a nonthermal plasma, provided that the ion and electron velocity distributions are consistent with the condition of charge neutrality. Motion in one dimension for a collision-free plasma, and for a plasma in which collisions are important, is studied as a model. The solution to the equations neglecting collisions indicates that potential gradients may exist over length scales which depend only upon the boundary conditions. Collisions, particularly ionizing collisions of electrons with a background gas, determine a length scale, and maintain the charged-particle velocity distribution required for charge neutrality. The production mechanism, collisional losses, and transverse diffusion are accounted for in a numerical calculation of self-consistent solutions for the plasma potential gradient in the Penning discharge, in which the one-dimensional character is preserved by a strong magnetic field parallel to the axis of the discharge. The computational results for the potential gradient are compared to experimental data obtained from a Penning discharge with emitting and conventional Langmuir probes, and by a momentum analysis of the accelerated ions. The existence of axial potential gradients over length scales much greater than the Debye shielding distance is established. (auth)

19577 ENERGY DISTRIBUTION OF ELECTRONS IN THE POSITIVE COLUMN OF A NITROGEN DISCHARGE. J. D. Swift (Northern Polytechnic, London). p.343-51 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The energy distribution function f(V) of the electrons in the positive column of a nitrogen discharge in a tube of 9 cm diameter is determined by means of a spherical Langmuir probe, for gas pressures between 0.2 and 0.05 mm Hg and discharge currents between 50 and 400 ma. The form of f(V) indicates that two groups of electrons are present with density peaks at energies of ≈2 and 7 ev. The slow group is shown to be an electron swarm whose mean energy is largely determined by X/p where X is the longitudinal electric field in the column. (auth)

19578 MICROWAVE MEASUREMENTS OF THE RADIATION TEMPERATURE OF A PLASMA IN A MAGNETIC FIELD. H. Fields (Microwave Associates, Inc., Burlington, Mass.), G. Bekefi, and S. C. Brown. p.367-75 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The microwave-frequency emission from the positive column of a d-c glow discharge was used to determine the discharge's radiation temperature. The positive column was subjected to an axial magnetic field not exceeding 2000 gauss. The emission was measured with a radiometer at a frequency of 3000 Mc, and a technique was adopted that rendered the interpretation of the temperature, independent of the plasma absorptivity. The main departure of the measured radiation temperature from the predicted electron temperature was observed at a frequency equal to the electron cyclotron frequency. Here large resonances of the radiation temperature were observed in neon, argon, and xenon, while no resonances were observed in hydrogen and helium. These results are shown to be consistent with calculations of the radiation temperature from plasmas with non-Maxwellian electron distributions. (auth)

19579 SCHLIEREN PHOTOGRAPHY OF AN R. F. PLASMA. U. Ascoli-Bartoli, A. de Angelis, and S. Martellucci (Euratom-CNEN, Frascati, Italy). p.376-9 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A method of measuring electronic and atomic density gradients in a plasma based on the Schlieren effect is discussed. Schlieren photographs of a radio-frequency-excited plasma in argon at a pressure of 10 Torr are shown. From photometric measurements, the radial distributions of the electronic and atomic densities are determined. (auth)

19580 COMPARISON OF SPECTROSCOPIC STUDIES WITH MICROWAVE AND PROBE MEASUREMENTS. G. von Gierke, L. Lisitano, G. Mueller, H. Schlueter, M. Tutter, and H. Wulff (Max-Planck-Institut für Physik und Astrophysik, Munich). p.380-8 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

Spectroscopic, microwave, and electric probe methods are compared as regards their application to a hydrogen radiofrequency discharge with static magnetic field. Investigations of the Balmer lines and of the recombination continuum, measurements of the absorption and the Faraday rotation of 8.7-mm waves, and the evaluations of double probe characteristics give consistent results. (auth)

19581 MAGNETIC FIELD DEPENDENT MICROWAVE RADIATION FROM A He-GAS DISCHARGE. G. Landauer (Max-Planck-Institut für Physik und Astrophysik, Munich). p.389-94 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

Microwave radiation is investigated from a Penning discharge in He. This radiation appears at a series of distinct values of the magnetic field between 0 and 2000 gauss. The microwave receivers work at 35 and 10 kMc. The intensity of the radiation depends on the pressure and the current of the discharge. The values of the magnetic field at which radiation appears are independent of these

parameters. About 20 single maxima of radiation can be received in the 35 kMc range. The corresponding values of the electron-cyclotron frequency f_e are compared with the frequency of the receiver f. There is a linear dependence of the ratios f/f_e, which may be understood by the appearance of harmonics of the electron-cyclotron frequency. (auth)

19582 MICROWAVE MEASUREMENT OF ELECTRON DENSITY DISTRIBUTIONS IN PLASMA COLUMNS. G. E. Stewart and Z. A. Kaprielian (Univ. of Southern California, Los Angeles). p.395-404 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Some applications of the arc discharge tube in the study of electromagnetic interaction with plasmas require knowledge of the spatial distribution of electrons in the tube. Commonly the region of the discharge called the "positive column" is used to provide a relatively uniform, slightly ionized plasma. In the positive column the electron density (ρ) is a function only of the radius. A method of measurement of ρ by expanding ρ in a series of orthonormal polynomials of the radius is described, the coefficients of which are evaluated by the shift in resonant-frequency microwave-cavity modes. (auth)

19583 MICROWAVE-POLAR-INTERFEROMETER FOR CONFINED PLASMA MEASUREMENTS. Guiseppe Lisitano (Max-Planck-Institut für Physik und Astrophysik, Munich). p.405-16 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

The phase and amplitude variations of an electromagnetic wave sent through a plasma are displayed in a polar plot. The method is arranged to furnish a sine interference The phase-time display of an interferometer can also be displayed with one or more "fringes." (auth)

19584 TECHNIQUES AND EQUIPMENT FOR MEASURING THE DENSITY OF PLASMA OF THE ORDER OF $10^{14}e/cm^3$. M. Dagal (Centre d'Études Nucléaires, Saclay, France). p.417-22 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

A description is given of 2-mm microwave interferometers, used to measure plasma densities up to 2.8×10^{14} electrons per cubic centimeter. Techniques analogous to those used in optics are employed to investigate plasmas contained in magnetic bottles. (auth)

19585 MEASUREMENT OF THE ELECTRONIC DENSITY BY THE FARADAY EFFECT. T. Consoli and M. Dagal ([Centre d'Études Nucléaires, Saclay, France]). p.423-30 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

The rotation of a linearly polarized wave crossing a plasma column is determined. From a system of curves the electron density can be found. The experimental arrangement is described and some results given. (auth)

19586 NOISE POWER RADIATION FROM NON-EQUILIBRIUM CYLINDRICAL PLASMAS WITH ONE-DIMENSIONAL THERMAL VELOCITIES. Philip Parzen (Republic Aviation Corp., Farmingdale, N. Y.). p.431-6 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A current-source method is used to compute the noise power radiated from a homogeneous nonequilibrium cylindrical plasma with longitudinal thermal velocities only. Explicit expressions for the frequency spectrum and radiation directivity are obtained in the form of rapidly converging series. Possible techniques for overcoming some of the limitations are indicated. (auth)

19587 EXPERIMENTAL CONTRIBUTION TO THE THEORY OF SPECTRAL LINE BROADENING. K. Bergstedt, E. Ferguson, H. Schlueter, and H. Wulff (Max-Planck-Institut für Physik und Astrophysik, Munich). p.437-48 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

Profiles of Balmer lines emitted from a h-f discharge with upper main quantum numbers up to sixteen are measured and compared with Holtsmark line profiles. Profiles of the He II lines at 4868 and 3203 Å emitted from a pulsed arc discharge are measured photographically and compared with the profiles delivered by the Holtsmark theory and a quantum mechanical theory. (auth)

19588 THE EFFECT OF A PREVIOUS GLOW DISCHARGE ON THE TOWNSEND IONIZATION COEFFICIENTS. J. Smith (Mullard Research Labs., Redhill, Surrey, Eng.). p.449-57 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

When a glow discharge between two electrodes is extinguished, the breakdown voltage of the gap is found to be affected for times much greater than can be accounted for by incomplete deionization. This is caused by the nonuniform gas density distribution, which is caused by the increase in cathode temperature. The effect of this nonuniform distribution on the ionization coefficients is investigated using a fixed-gap method. The results indicate that the effective value of γ (the number of electrons emitted) upon extinction of the discharge is not increased in conformity with the increase in the field/density ratio at the cathode. It is shown that the reduction of the minimum breakdown voltage below the normal value, which is observed upon increasing the cathode temperature, can be explained. (auth)

19589 NATURAL RESONANCES OF MAGNET-IONIC PLASMAS. Louis Gold (Univ. of Michigan, Ann Arbor). p.458-64 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The behavior of a multi-species plasma in the presence of an externally applied magnetic field is shown to be analogous to that of N-coupled harmonic oscillators. This means that both the natural frequencies and the relative amplitudes of the oscillations are derivable from a secular solution for the conservative motion of the charges. Moreover, approximation methods may be adapted to solving the secular determinant that is obtained through an electrostatic mode analysis. This formalism follows from the recognition that the essential coupling enters either as an effective Lorentz field, or equivalently from the combined currents of the distinguishable carriers. (auth)

19590 APPLICATION OF THE PROPAGATION OF RIGHT CIRCULARLY POLARIZED WAVES TO THE DIAGNOSTICS OF U.H.F. T. Consoli, M. Dagal, and D. Lepechinski ([Centre d'Études Nucléaires, Saclay, France]). p.465-70 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

A method is described based on the determination of the group velocity. It is shown that near its maximum, the velocity is very sensitive to variations of the electron density N_e, and that the abscissa of this maximum is itself

a function of the static magnetic field. Thus a longitudinal measure of the density, or a measure of the magnetic field B in the plasma if N_e is already known, can be performed. (auth)

19591 OSCILLATION IN A DARK PLASMA. Shoji Kojima (Tokyo Univ. of Education), Shigeo Hagiwara, and Kazuo Takayama. p.471-7 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A homogeneous dark plasma was produced in a discharge tube having a pair of anode-cathode systems near its walls. The tube was a pyrex sphere, 30 cm in diameter, filled with mercury vapor at 10^{-4} mm Hg. Plasma electron oscillations of about 15 Mc were observed by using a regenerative detector through a probe or an antenna. The frequencies of plasma oscillations were distributed in a narrow region corresponding to a small nonuniformity of electron density. The oscillations were also detected by a radiofrequency amplifier. The voltage of the plasma oscillation measured by the probe was on the order of 10^{-3} v. (auth)

19592 THE EXPERIMENTAL STUDY ON THE IONIC WAVE IN THE DARK PLASMA. Yoshisuke Hatta and Noriyoshi Sato (Tohoku Univ., Sendai). p.478-84 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A method is described to excite ionic longitudinal waves in a dark plasma, and measurements of the phase velocity and the damping of the waves are reported. The frequency used is much lower than that of the ionic plasma oscillation. The results are consistent with the dispersion relation calculated taking into account collisions between ions and neutral atoms. (auth)

19593 CYCLOTRON WAVE NONCONVECTIVE INSTABILITY. A. W. Trivelpiece and R. J. Maxum (Univ. of California, Berkeley). p.485-91 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The cyclotron waves on oppositely directed interpenetrating electron beams or plasmas of finite transverse cross section in a finite axial magnetic focusing field interact to give a nonconvective or time growing instability. This instability, unlike the space-charge-wave nonconvective instability, is possible for physically realizable electron beams. If the d-c drift velocity of the two oppositely directed beams is slightly different, a disturbance propagates in space and grows in time. In addition to this type of instability, the space-charge waves of one beam can interact with the cyclotron wave on the other beam. (auth)

19594 MILLIMETREWAVE NOISE OF A PLASMA. P. A. H. Hart and G. H. Plantinga (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). p.492-9 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Measurements of the microwave radiation temperature of a positive column of helium, neon, argon, krypton, and xenon are presented. Measurements are performed at wave lengths of 8 and 4 mm. The results are compared with the temperatures measured at 30 mm. When the plasma is sufficiently quite opaque, agreement is obtained between the measured temperatures. The microwave radiation can be calculated from the absorption coefficient and the radiation temperature. The radiation temperature is, in the cases studied, equal or nearly equal to the electron temperature as follows from experiments. (auth)

19595 LIMIT CASES OF ELECTROMAGNETIC WAVES IN PLASMAS. H. Poeverlein (Air Force Cambridge Research Labs., Bedford, Mass.). p.500-6 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Wave-theoretical formulations are derived for various limiting cases of small-amplitude electromagnetic waves in a cold plasma with magnetic field. The limiting cases correspond to Alfvén waves (in a perfectly or imperfectly conductive plasma), whistler waves (as met with in the higher atmosphere), and various propagation conditions implying no Hall current. In some cases the two electromagnetic propagation modes appear separated, represented by two uncoupled wave equations. The characteristics of the individual modes, in particular anisotropy or isotropy of their propagation, are indicated in the formulas. (auth)

19596 A RADIO WAVE IN A PLASMA IN A UNIFORM MAGNETIC FIELD. Toyoki Koga (Univ. of Southern California, Los Angeles). p.507-16 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Considering a plausible model of plasmas where molecules are partly ionized, Boltzmann-type equations are proposed for ions and for electrons. By introducing "generalized moments" of the distribution functions, the equations may be solved to obtain the conductivity of a plasma to an oscillating electric field in the presence of an imposed magnetic field. The propagation of a radio wave in the plasma is investigated. As special cases, theories of hydromagnetic and radio waves in plasmas with no imposed magnetic field are included. (auth)

19597 HIGH FREQUENCY PROPAGATION ACROSS AN ION PLASMA WAVE. J. E. Drummond (Boeing Scientific Research Labs., Seattle). p.517-27 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Ion wave theory is extended to include nonlinearities. The high-frequency oscillatory motion of electrons in the finite amplitude ion wave potential troughs is analyzed. The zeroth, fundamental, second, and third Fourier harmonic components of the electron velocity are found for two cases. From these the high-frequency conduction response of the plasma is computed. This yields a region of reverse phase response indicating an electromagnetic transmission band well below the electron plasma frequency. (auth)

19598 IMPEDANCE-PRESSURE CHARACTERISTICS OF GLOW DISCHARGE TUBES. G. F. Weston (Mullard Research Labs., Redhill, Surrey, Eng.). p.528-36 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The variation of the impedance of glow discharge tubes with pressure is measured in the audiofrequency range. No simple law can be obtained relating the impedance or its measured components with pressure. The results, however, can be explained in terms of theory if the "self-inductance" varies inversely as the pressure and the "degression time" remains constant for a particular current. (auth)

19599 TRANSITION FROM FREE TO AMBIPOLAR DIFFUSION IN AN ELECTRODELESS DISCHARGE. Hans U. Eckert (Convair Scientific Research Lab., San Diego, Calif.). p.537-44 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

An approximate relationship for the effective diffusion coefficient in the transition region between free and ambipolar diffusion is incorporated into the characteristic equations for a steady-state inductive radiofrequency discharge.

The resultant relationship is evaluated for hydrogen. It furnishes equilibrium values for the induced electric field at the tube wall and substantiates the assumption that ambipolar diffusion is established when the skin depth becomes of the order of the tube radius. A plot of electron density against the applied magnetic field reveals that the transition zone is unstable. (auth)

19600 ON THE PUMP EFFECT OF A HIGH FREQUENCY DISCHARGE IN DEUTERIUM. E. Blauth, E. Meyer, and F. Schwirzke (Max-Planck-Institut für Physik und Astrophysik, Munich and Institut für Plasmaphysik, Garching, [Ger.]). p.545-9 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

A h-f discharge in an ultrahigh-vacuum system is used to produce atomic deuterium. It is shown that most of the gas deposited on the walls and in the liquid nitrogen trap is D_2O. Whether the small part of D_2 found in the gas is originally adsorbed as atomic D or included as D_2 is undecided. (auth)

19601 STATIONARY AND RUNNING STRIATIONS IN A RADIO FREQUENCY DISCHARGE. J. A. Rich (General Electric Research Lab., Schenectady, N. Y.). p.558-65 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The behavior of striations in a toroidal discharge in xenon excited by a traveling magnetic field (phase velocity = 6×10^7 cm/sec) was studied. The slow-wave line consisted of a capacitively loaded helix wound on a glass toroid and terminated in its characteristic impedance. The effect on the striation frequency (and velocity) of varying the r-f line current is shown: when the gas pressure in the toroid is taken as a parameter; and when the magnitude and direction of the axial magnetic field in which the plasma is immersed are taken as parameters. (auth)

19602 CRITICAL CURRENTS FOR MOVING STRIATIONS IN THE INERT GASES. A. W. Cooper and N. L. Oleson (U. S. Naval Postgraduate School, Monterey, Calif.). p.566-72 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Limiting currents for the presence of moving striations in the positive columns of hot cathode glow discharges in inert gases are investigated using rotating-mirror photography and photoelectric techniques. The critical current decreases monotonically with increasing pressure and increases with increasing tube diameter and distance from the cathode to the point of observation. Observation in a tube having sections of different diameter show that striation parameters change abruptly in a distance of the order of a wave length near the junctions. Regular striation patterns in regions of large tube diameter may be separated by sections of smaller diameter showing no coherent oscillation. (auth)

19603 THE PHYSICAL MECHANISM OF A WAVE OF STRATIFICATION IN A DISCHARGE PLASMA. L. Pekarek and V. Krejčí (Czechoslovak Academy of Sciences, Prague). p.573-81 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The following three phenomena are decisive for the production of moving striations in a plasma: the dependence of the ionization coefficient z on the electron temperature and hence on the electric field in the plasma; the production of space charges as a result of different diffusion rates of the charge carries; and the creation of additional electric fields as a result of the creation of space charges. Two possible ways of simplifying the mathematical formulations of these phenomena in basic equations are dealt with, and it is shown that the principal properties of the solution of these equations agree with the experimental properties of the process of production of moving striations after an aperiodic disturbance (wave of stratification). (auth)

19604 THE EFFECTS OF FLUCTUATIONS ON PROPAGATION THROUGH A PLASMA MEDIUM. G. S. Kino and M. A. Allen (Stanford Univ., Calif.). p.602-11 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Random fluctuations of the electron density of a plasma medium degrade the characteristics of a microwave signal passed through the medium. The examination on a spectrum analyzer of an r-f signal passed through a laboratory plasma reveals a transfer of energy into side-bands of the original frequency. In d-c discharges the main components observed are those arising from the strong oscillations that occur in the low-frequency range (below one megacycle). A theory of phase modulation of an r-f signal by the low-frequency fluctuations of a plasma is described. It is shown that strong sidebands should be expected, and that under certain circumstances the original carrier amplitude may become zero. The results obtained agree with experimental measurements carried out on a plasma column modulated in density by an external low-frequency signal. (auth)

19605 THE VERY EARLY AFTERGLOW IN GASEOUS HELIUM. J. M. Anderson (General Electric Research Lab., Schenectady, N. Y.). p.621-9 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Measurements by optical and microwave techniques on electron removal processes in the afterglow established in helium are reported (<100 microseconds from electrical excitation). Observation of the intensity of visible and near-visible molecular band emission leads to the conclusion that two mechanisms should probably be invoked for formation of these radiating states. The first process is presumably that of electron and positive molecular ion recombination and the second process is tentatively ascribed to inverse predissociation induced by collisions of slow electrons. The recombination coefficient for the first process is determined to be $\approx 2 \times 10^{-9}$ cm^3/ions. (auth)

19606 SPECTROSCOPIC MEASUREMENTS OF HELIUM AFTERGLOW. E. Hinnov and J. G. Hirschberg (Princeton Univ., N. J.). p.638-50 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The rate of disappearance of electrons, and the characteristics of the afterglow spectrum observed in a quiescent helium plasma produced in the B-1 stellarator are explained, in terms of three-body electron-ion recombination. From measurements of absolute line intensities originating from highly excited levels, electron densities and temperatures are deduced that are in agreement with those obtained from microwave phase shift and plasma conductivity measurements. An approximate formula for the recombination coefficient is derived, and the coefficient is calculated as a function of electron density and temperature in the range $0.1 < kT < 0.4$ ev and $10^{11} < N_e < 10^{13}$ cm^{-3}. (auth)

19607 RECOMBINATION IN A HELIUM PLASMA. R. W. Motley and A. F. Kuckes (Princeton Univ., N. J.). p.651-9 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Studies of the plasma loss in the afterglow of discharges

in the B-1 stellarator show that the three-body recombination reaction $He^+ + e^- + e^- \rightarrow He^* + e^-$ is the principal mechanism for charge removal in a highly ionized, low-temperature helium plasma. This conclusion is drawn from evidence obtained by microwave measurements of the time dependence of the plasma electron density, and from conductivity measurements of the electron temperature. (auth)

19608 THE INFLUENCE OF CATHODIC SURFACE LAYERS ON TOWNSEND DISCHARGE PARAMETERS IN HYDROGEN. D. E. Davies, G. A. Dawson, and C. F. Gozna (University Coll. of North Staffordshire, Keele, Staffordshire, Eng.). p.671-7 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Experimental tubes, prepared by ultra-high-vacuum techniques, are used to measure the effect of vacuum materials such as oils, mercury vapor, and alien metals on the work function of freshly prepared metallic film cathodes. The influence of thick oxide (thermionic) layers on sparking potentials and on secondary coefficients in hydrogen, together with the effect of cathode temperature on these parameters, is reported. In addition, for clean metal surfaces a relationship between the work function of the cathode surface and the minimum sparking potential is confirmed. Formative time-lag measurements give information about the secondary process in hydrogen with clean cathode surfaces. (auth)

19609 TOWNSEND IONIZATION COEFFICIENTS AND THE BREAKDOWN OF PASCHEN'S LAW IN HYDROGEN, DEUTERIUM, AND MERCURY VAPOUR. D. E. Davies, D. Smith, and J. Myatt (University Coll. of North Staffordshire, Keele, Staffordshire, Eng.). p.678-86 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Townsend ionization coefficients are determined under uniform field conditions for hydrogen, deuterium, and mercury vapor. For H_2 and D_2 the application of ultra-high-vacuum techniques, the use of evaporated metallic films on a glass substrate as cathode, and the careful purification of the gases contribute to the cleanliness of the experimental tubes, and thus to low experimental values of α/p_0. In mercury vapor, values of α/p_0 are also presented. Deviations from Paschen's law near the minimum sparking potential are reported for hydrogen and for mercury vapor. (auth)

19610 DISCHARGE AT VERY LOW PRESSURE IN CROSSED STATIC FIELDS. P. Hubert (Centre d'Études Nucléaires, Fontenay-aux-Roses, France). p.687-92 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

A Penning-type device using a corrugated electric potential distribution gives breakdown at pressure below 10^{-5} Torr. Formative time lags from one second up to one minute are observed and measured as a function of voltage. The comparison made with a magnetron configuration shows that in this case breakdown is also made easier by application of a corrugated potential. An attempt to switch from electrostatic to magnetic mirror trapping of the electrons observed on the axis gives a population of low-energy electrons with a decay time of a few milliseconds. (auth)

19611 A THEORETICAL AND EXPERIMENTAL STUDY OF SHORT DURATION BREAKDOWN TIMES IN LOW PRESSURE GASES. J. Lucas (Imperial Coll. of Science and Tech., London). p.693-706 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A model is proposed for breakdown, for cases in which individual avalanches have large space-charge effects. The breakdown time depends critically both on the rate of electron emission from the cathode and on the nature of the (α, E) curve. Experimentally measured breakdown times in argon gas at low pressures are given. (auth)

19612 VERY LOW PRESSURE GAS BREAKDOWN USING SECONDARY ELECTRONS. M. A. Levine (Air Force Cambridge Research Labs., Bedford, Mass.) and A. G. Rubin. p.707-17 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Breakdown is produced in hydrogen and helium at pressures down to 10^{-6} mm Hg in a toroidal chamber placed in a uniform r-f field. An explanation of the breakdown characteristics is attempted, which relies on secondary electron emission from the walls to produce the initial rapid rise in electron density. An electrostatic wall field and an effective radial potential well arising as a result of the r-f field are invoked to explain long containment times. (auth)

19613 THE INFLUENCE OF PRESSURES WITHIN THE RANGE $10^{-6} - 10^{-3}$ mm Hg ON BREAKDOWN BETWEEN PLANE ELECTRODES. A. Maitland (Associated Electrical Industries, Ltd., Manchester, Eng.). p.718-30 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Using air, hydrogen, argon, and propane, respectively, and electrodes of copper or nickel, it is shown that a pressure increase of one or more orders of magnitude under continuously pumped conditions increases the statistical time-lag to breakdown. (auth)

19614 IONIZATION COEFFICIENTS AND UNIFORM FIELD BREAKDOWN IN ARGON FOP LOW VALUES OF E/p. D. E. Golden and L. H. Fisher (New York Univ., New York). p.731-3 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Pre-breakdown ionization currents in argon at low values of the ratio of field strength to pressure lead to discoveries of anomalies in the Townsend ionization coefficients. Paschen's law is also found invalid. (auth)

19615 BREAKDOWN OF ARGON IN GLASS CELLS WITH EXTERNAL ELECTRODES AT STEADY AND 60-CYCLE ALTERNATING POTENTIALS. L. B. Loeb and J. M. El-Bakkal (Univ. of California, Berkeley). p.734-41 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Breakdown in argon below 35 mm Hg in borosilicate glass cells with external electrodes is investigated using four different experimental techniques, including steady and 60-cycle alternating potentials. Townsend-like breakdown occurs above the normal Townsend threshold. Above threshold small discharges reduce the internal field by wall charges. At higher over-voltages short intense breakdowns annihilate external fields and wall charges are proportional to applied potential. Very high over-voltages yield streamer-like breakdown of ultrashort rise time. The short duration of discharge confines breakdown to narrow channels even at lower pressures, the charges later spreading over electrode surfaces. (auth)

19616 HIGH-FREQUENCY PLASMOIDS. Albert J. Hatch (Argonne National Lab., Ill.). p.748-55 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

R-f potentials are measured with probes as functions

of axial position in high-frequency plasmoids. The plasmoids are established in dry air at pressures from 0.2 to 1 micron Hg between plane-parallel aluminum electrodes, 23 cm in diameter and 15 cm apart, at a frequency of 15 Mc. The 15-Mc potential in the plasmoid is observed to be 180° out of phase with the applied potential. This and other results support the hypothesis that longitudinal oscillations of electrons in the plasma play a dominant role in the plasmoid mechanism, and lead to an explanation of the dark sheath. (auth)

19617 THE BUILDING UP AND THE SPREAD OF THE DISCHARGE IN HALOGEN COUNTERS. H. Martinides, K. Nienhuis, and K. Van Duuren (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). p.756-62 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

It was shown that photons and not metastables determine the building up and spread of the discharge in halogen counters at higher overvoltages. The influence of bromine pressure on the buildup time was investigated. By means of a double counter experiment it was demonstrated that there was a very copious production of active photons. Velocities of spread were much larger than those measured in argon-alcohol counters. Values were found between 0.5 and 5.10^8 cm/sec. (auth)

19618 THE EQUIVALENT PRESSURE CONCEPT FOR IONIZATION IN A TRANSVERSE MAGNETIC FIELD. S. C. Haydon (Univ. of New England, Armidale, New South Wales, Australia). p.763-70 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The equivalent-pressure approach to problems of electrical breakdown in crossed fields is examined, using information concerning the variation with E/p_0 and H/p_0 of pre-breakdown ionization coefficients in hydrogen gas. It is confirmed that the magnetic field H effectively increases the gas pressure p_0 by the factor $\sqrt{1 + C(H/p_0)^2}$, but that to account for the minimum value of sparking potential in crossed fields and the detailed variations of α/p_0 with E/p_0 and H/p_0, that C must increase with E/p_0. (auth)

19619 ELECTRON DISTRIBUTIONS IN H_2 GAS AT HIGH E/P. G. W. Stuart (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.771-8 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A model is studied for the behavior of electrons in an infinite medium of H_2 gas with a constant electric field (E). The assumptions that define the model make it appropriate for high E/p. Exact solutions of the time-dependent Boltzmann equation are obtained for the Laplace transform of the single-electron distribution function averaged over velocity orientation, both with and without inclusion of a collisional energy-loss mechanism. These Laplace transforms are used to generate exact solutions for the time-growing (through ionization) part of the many-electron distribution function averaged over velocity orientations. These later solutions exhibit steady-state velocity distributions. An attempt is made to determine the E/p below which the model is not valid. (auth)

19620 THEORY OF COLUMN WITH DEPENDENT CARRIER SUPPLY IN MAGNETIC FIELDS. G. Ecker (Universität, Bonn). p.779-85 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

A model is investigated for experimental application to the Cs discharge. An infinite, cylindrical discharge vessel of diameter 2R lies in a longitudinal magnetic field B. There is a coaxial core of diameter $2r_0$ that contains electrons and ions of equal temperature T_0, which provides an electron and an ion current of density Γ_0 entering the rest of the discharge volume from the edge of the core (r_0). Electrons and ions diffuse across the magnetic field to the wall, where they recombine. The mean free path of electron–ion collision is assumed small compared with 2R. There is no neutral particle component. The calculation of this problem on the basis of the transport equations shows that there is a strong variation of the temperature across the discharge vessel. The density distribution is influenced by this variation. Density and temperature distributions are evaluated with the help of a computer. The eigenvalue for the particle density at the edge of the core is determined as a function of Γ_0 for various magnetic fields. A similarity law is given. (auth)

19621 QUIESCENT CESIUM PLASMAS IN STEADY STATE. R. C. Knechtli and J. Y. Wada (Hughes Research Lab., Malibu, Calif.). p.786-95 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A method of generating highly ionized, quiescent, steady-state plasmas is presented. Plasma densities in excess of 10^{12} ions/cm^3 at 90% ionization are obtained. The validity of double-probe measurements of plasma density and temperature in the presence of a d-c magnetic field is established. The recombination coefficient α of highly ionized cesium plasmas up to densities exceeding 10^{12} ions/cm^3 is to be $< 2 \times 10^{-11}$ cm^3/sec. (auth)

19622 MICROWAVE DIAGNOSTICS FOR HELIUM–CESIUM PLASMAS. B. C. Lindley and I. R. McNab (C. A. Parsons & Co. Ltd., Newcastle-upon-Tyne, Eng.). p.796-805 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Experiments are conducted to obtain the electrical properties of inert gas-alkali metal plasmas, particularly helium–cesium mixtures, at pressures from 40 to 760 mm Hg and temperatures up to 3000°K. Factors affecting the electron collision frequency, encountered in theoretical expressions for d-c electrical conductivity, are discussed. The theory of the interaction of an electromagnetic wave with a plasma is adapted for microwave diagnostic measurements. (auth)

19623 THE DIRECT CONVERSION OF THERMAL ENERGY INTO ELECTRICAL ENERGY. S. Klein (Centre d'Études Nucléaires, Saclay, France). p.806-14 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

A large separation of positive and negative electric charges is obtained in a jet of ionized vapor, metallic or otherwise (mercury, cesium, and water) which tends to condense at room temperature. These pressurized vapors, ionized by a h-f source, enter through a vent into an expansion chamber that contains several electrodes, in which a partial vacuum is set up. These vapors, made up of molecules, ions, and electrons, traverse the vent and the electrodes and expand at different velocities and an electromotive force is produced between the electrodes. Similar results are obtained using other ionization processes (flame, ultraviolet light, and radioactive elements). The voltage distribution in the hot gas in relation to the electrodes is measured by means of small wire electrodes. The separation of electrical charges is obtained without applying an electrical or magnetic field in the vicinity of the electrodes. The difference of temperature between the

electrodes plays an essential part in the phenomenon. If the electrodes are at the same temperature, no electromotive force is produced. (auth)

19624 ON A NEW GAS-FILLED THERMIONIC CONVERTER. W. Bloss (Technische Hochschule, Stuttgart). p.815-18 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

On the basis of theoretical treatment of the efficiency of thermionic energy converters, experiments are performed using converter models having cathode temperatures not exceeding 1000°C. The influence of a low-pressure plasma that is generated in an auxiliary discharge on the efficiency, and the effect of pressure and kind of gas is investigated. Noble gases with great mass numbers prove advantageous. By means of the auxiliary discharge, the output current can be controlled. By this means it is possible to use the converter an an a-c generator operating up to about 1000 cps. (auth)

19625 THE RESISTANCE OF A PLASMA FOR A THERMIONIC CONVERTER. D. A. Fraser (General Electric Co. Ltd., Wembley, Eng.). p.819-24 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Measurements are made of the voltage-current characteristics of an independently produced plasma between two emitting electrodes. It is shown that the observed characteristics can be accounted for by the changes of the sheath voltages at the two electrodes, the plasma remaining closely unipotential. (auth)

19626 KINETIC EQUATION FOR PLASMAS WITH COLLECTIVE AND COLLISIONAL CORRELATIONS. C. M. Tchen (National Bureau of Standards, Washington, D. C.). p.825-41 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A kinetic equation for plasmas is derived. The effects of double and triple correlations are investigated. Emphasis is given to the formulation of the long-range collective force, the collision force of shorter range, the mixing force between the two ranges, and the shielding mechanism. A consistent study is advanced concerning the time development of the double correlation function. In view of applications to plasma oscillations, the distribution functions are perturbed. The unperturbed double correlation and its perturbation are found, the latter as the solution of a singular integral equation. (auth)

19627 A GAS-WHIRL STABILIZED ARC IN PURE HYDROGEN ATMOSPHERE AS A PRE-IONIZATION PATH FOR A HIGH-CURRENT IMPULSE DISCHARGE. E. Pfender and W. Bez (Technische Hochschule, Stuttgart). p.897-906 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

The representation of a gas-whirl-stabilized arc in hydrogen atmosphere is examined, which arc satisfies certain requirements as a pre-ionization path for a high-current impulse discharge. Arcs carrying between 30 and 150 amp are considered. Field intensities of 50 to 100 v/cm are measured. The dependence of the diameter of the plasma column on the input per unit length of the column is determined. The behavior is compared with that of a nitrogen and argon discharge. By spectroscopic measurements the axle temperature of the hydrogen arc (up to T = 24.000°K) and the radial temperature dependence are determined. (auth)

19628 EXPERIMENTAL STUDY OF THE STARK BROADENING OF THE BALMER LINE $H\gamma$. W. L. Wiese, D. R. Paquette, and J. E. Solarski (National Bureau of Standards, Washington, D. C.). p.907-12 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A hydrogen plasma was generated in a wall-stabilized arc and the profile of $H\gamma$ was measured photoelectrically. Temperature and particle densities were determined by measuring the total intensity of $H\gamma$ and using the usual equilibrium and conservation equations for reacting gases. The observed profile was then compared with theoretical profiles. (auth)

19629 GENERAL THEORY OF COLLISION BROADENING OF SPECTRAL LINES. Oldwig Von Roos (California Inst. of Tech., Pasadena). p.913-24 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A quantum mechanical theory of spectral line broadening is developed. The theory incorporates Doppler broadening and collision broadening in a natural way. By working in the interaction representation with respect to the collisional degrees of freedom and taking inelastic collisions fully into account, general formulas are derived for the line shift, the line breadth, and the line shape of an optical spectral line of an arbitrary quantum mechanical system, provided that the line breadth is small compared to the emitted frequency and that the final state is stable (ground state). (auth)

19630 DISPERSION RELATIONS IN A FULLY IONIZED HYDROGEN PLASMA. Arne A. Wyller (Air Force Cambridge Research Labs., Bedford, Mass.). p.940-54 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The effects of electron-proton (e-p) and electron-electron (e-e) collisions are incorporated into the dispersion relations for electromagnetic wave propagation in a fully ionized hydrogen plasma under the influence of an external magnetic field. The e-p collisions dominate the e-e collisions outside the realm of gyroresonance. At gyroresonance, however, the e-e effects strongly diminish the absorptivities. In this case, by far the largest absorptivity occurs for the extraordinary ray in longitudinal propagation. The Appleton-Hartree magneto-ionic formula, as generally applied to the solar atmosphere, is found applicable in a limiting case using a particular expression for the "effective" e-p collision frequency. (auth)

19631 SPECTROSCOPIC MEASUREMENTS OF THE TEMPERATURE OF PLASMA JETS. R. E. Jahn (British Oxygen Co. Ltd., London). p.955-66 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Several methods are used for determining the temperature of a plasma jet derived from argon containing 5% hydrogen, based on the absolute intensity of the H_α or H_β line, the relative intensity of the H_α and H_β lines, and the profile of the H_β line. Intensity measurements are made photoelectrically to avoid the errors inherent in photographic photometry. Agreement is obtained between the temperatures derived using these different methods. In order to allow the temperature of an argon plasma not containing hydrogen to be determined, the transition probabilities of two argon lines are measured. (auth)

19632 A NEW TYPE ARC FOR PRODUCING HIGH TEMPERATURE, HIGH PURITY PLASMA JETS. John Hoiton McGinn (General Electric Co., Philadelphia). p.967-75 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The design and performance of an arc heating device is described for the production of a uniform, high-temperature plasma jet of arbitrary composition. Salient features of the design are: a method for dividing the incoming gas to eliminate contamination of the jet by electrode material, a constricted arc column, and small dimensions to minimize energy losses. Operating conditions achieved with air fall within the following ranges: mass flows of 0.5 to 5.0 g/sec; stagnation pressures of 0.7 to 11.0 atm; enthalpy up to 12000 cal/g; and running times up to 15 min. Spectrographic and calorimetric measurements are discussed. (auth)

19633 A LOW-PRESSURE SPARK-GAP SWITCH WITH WIDE VOLTAGE RANGE. R. B. Johansson and E. A. Smårs (Royal Inst. of Tech., Stockholm). p.1040-7 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

A triggered spark-gap switch operating at low gas pressure is described. Its working voltage range extends from a few hundred volts to at least 50 kv. At suitable pressure and polarity its delay time is less than 50 ns and its jitter time is less than 20 ns, both decreasing with decreasing gap voltage. At reversed polarity they are up to 10 times longer. (auth)

19634 ON THE IGNITION PROCESS IN WIRE EXPLOSIONS. H. Bartels, J. Bortfeldt, and K.-H. Berg (Technische Hochschule, Hanover). p.1048-51 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In German)

In exploding wires surrounded by gases, the cylinder of metal vapor is wrapped up by a plasma jacket of the surrounding gas. The creation of this plasma jacket is investigated. For this purpose the formation of the explosion during the first phase and the corresponding spectra are photographed cinematographically with high time resolution. The result is as follows: at the beginning of the explosion a discharge breaks down along the wire within the surrounding gas; then this discharge forms the plasma jacket independently of events within the wire. This jacket forms itself in the same manner even when the wire does not explode. (auth)

19635 PINCH EFFECT OF METALLIC PLASMAS OBTAINED BY EXPLODING WIRES. C. Aycoberry, A. Brin, F. Delobeau, and P. Veyrie (Centre d'Études Nucléaires, Saclay, France). p.1052-59 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

In a study of the pinch effect in metallic exploding wires, a 1 μf–100 kv capacitor is discharged through a thin metallic wire. The ringing frequency is 0.2 Mc. The observation of the exploded wire shows a pinch effect during the first microseconds. Oscilloscope recordings of current and voltage are given as well as streak-camera and Kerr-cell photographs. The approximate temperature reached at the time of the first maximum pinch is estimated. A description of the processes occurring during the explosion is outlined. (auth)

19636 SOME OPTICAL RADIATION PHENOMENA IN THE ARCS OF LOW PRESSURE INERT GASES. R. Feinberg and M. E. Roberts (Manchester Coll. of Science and Tech., Eng.). p.1060-4 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

The luminous intensity of radiation emitted during the pulse discharge of a capacitor from plasmas of various cold-cathode arc-conduction valves containing Ar, Ne, Kr, and Xe at low pressure, is oscillographically recorded. There is an afterglow for Ar and Ne, but none for Kr and Xe, in accordance with the shapes of the respective current pulses through the valves. The afterglow, when it occurs, starts with a peak value in excess of the radiation intensity at the end of the current pulse, and it contains distinct intensity humps whose occurrence appears to depend on gas pressure and valve diameter. Similar intensity humps occur in the Kr and Xe radiations, when the energy discharged through the valve is sufficiently high. (auth)

19637 HIGH CURRENT SPARK GAP RECOVERY. R. J. Churchill (Univ. of Liverpool). p.1075-81 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

An experimental technique and apparatus, employed for the measurement of spark gap reignition after the passage of a high-current discharge, is described. The high current is a critically damped waveform having its 235-ka peak occurring at 10 μsec, and the restriking voltage approximates a step-function over a 50 μsec period. Results are given for tungsten rod electrodes of 16 mm diameter in hydrogen, air, and argon, and for 4 mm diameter electrodes in hydrogen. It is shown that electrode mass has a pronounced effect upon the recovery process. Gas temperatures are derived on the basis of certain assumptions. (auth)

19638 MECHANISM OF REFLEX DISCHARGE AT EQUILIBRIUM. R. Geller and D. Pigache ([Centre d'Études Nucléaires, Saclay, France]). p.1111-18 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

The mechanism of operation of a pulsed reflex discharge at equilibrium is described. A relation is established between the plasma density and the discharge current. The coefficient of ambipolar transverse diffusion is determined experimentally. (auth)

19639 PULSED REFLEX DISCHARGE OF THE P.I.G. TYPE AT HIGH DENSITIES. T. Consoli, R. Geller, and R. Le Gardeur ([Centre d'Études Nucléaires, Saclay, France]). p.1119-25 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In French)

A pulsed reflex discharge capable of attaining electron densities up to $7 \times 10^{13}/cm^3$ and ionic temperatures of 25,000°K is described. The discharge parameters are given in graphical form. (auth)

19640 STRUCTURES OF MAGNETOHYDRODYNAMIC DETONATION WAVES. C. C. Chang (Aerospace Corp., El Segundo, Calif.) and Y. C. Whang. p.1126-39 of "Ionization Phenomena in Gases. Vol. I." Amsterdam, North-Holland Publishing Company, 1962. (In English)

Magnetohydrodynamic (MHD) detonation waves and their sturctures in electrically conductive gases are treated theoretically, with consideration to reaction energy release and transport properties. The energy release may be of thermonuclear origin for extremely high-temperature plasma or of chemical process for reactive gases under the influence of a specified magnetic field. With a simplified model of energy release and electric conductivity, the structures of the detonation waves are numerically calculated as examples. The results indicate that the MHD detonation wave thickness is much larger than that of a MHD shock wave under the same upstream conditions. The coupling between the shock zone and the reaction zone is strong. (auth)

Astrophysics and Cosmology

Refer also to abstract 18929.

19641 (NP-11625) LANDAU DAMPING OF TRANSVERSE WAVES IN THE EXOSPHERE BY FAST PARTICLE FLUXES. Technical Note BN-277. D. A. Tidman and R. K. Jaggi (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Feb. 1962. Contract NsG 220-62. 22p.

The Landau damping of transverse waves propagating in the thermal exospheric plasma by fast particle fluxes which also exist in these regions was also investigated. The most intense non-thermal fluxes so far detected are those of the auroral producing electrons and protons measured by McIlwain. It was found that these fluxes may considerably damp the propagation of whistler modes through some regions. The damping of hydromagnetic waves in the exosphere by this mechanism is negligible. (auth)

19642 SOME GEOPHYSICAL AND ASTRONOMICAL ASPECTS OF SOVIET SPACE RESEARCH. V. I. Krasovskii (Krassovsky) (Inst. of Atmospheric Physics, Academy of Sciences, USSR). Endeavour, 21: 65-72(Apr. 1962).

The principal geophysical and astronomical studies carried out in the Soviet Union as part of the scientific program in support of the project for manned space flight are described. The information obtained by satellites, space probes, and geophysical rockets was used to design manned satellites and space vehicles. At the same time this information led to the discovery of penetrating particles in the terrestrial magnetic field and the determination of their density and ionization in the upper atmosphere. (N.W.R.)

19643 PROPAGATION OF SOLAR CORPUSCLES AND INTERPLANETARY MAGNETIC FIELDS. Tatsuzo Obayashi (Arctic Inst. of North America, Washington, D. C.). J. Geophys. Research, 67: 1717-29(May 1962).

A model of interplanetary magnetic fields formed by the outward blast of solar plasma clouds is examined for various characteristics of solar particles observed on the earth. All available information on solar-geophysical data was examined, including flares, solar radio emissions, polar-cap absorptions, and geomagnetic and cosmic-ray storms for the period from July 1957 to December 1960. It is shown that a plasma cloud ejected from the sun forms an expanding magnetic bulge that is linked with the sun and can trap or sweep out solar cosmic rays, depending on the relative positions of the injected particles and of the cloud in space. The results also confirm some inequality of the time variations of solar cosmic-ray flux with respect to the heliographic position of the source flares. This is explained by the westward convex nature of magnetic field lines due to the rotation of the sun. The average speed and the lifetime of magnetic plasma clouds are estimated from the characteristics of delay times between solar flares and geomagnetic storms. (auth)

19644 MICROPULSATIONS AND HYDROMAGNETIC WAVES IN THE EXOSPHERE. F. L. Scarf (Univ. of Washington, Seattle and Space Technology Labs., Inc., Los Angeles). J. Geophys. Research, 67: 1751-61(May 1962).

Recent evidence indicates that the steady-state hydromagnetic wave spectrum in the lower exosphere is sharply cut off for frequencies above 1.5–3 cps. It is argued that the spectrum has this form essentially everywhere below $R \simeq 5R_e$ (geocentric) and that no model without a loss mechanism can reproduce the cutoff, because the ordinary and extraordinary circularly polarized waves are strongly coupled. Thermal damping is investigated by means of the collisionless Boltzmann equation; it is found that this effect may explain the observed cutoff if the proton temperature near $5R_e$ is of the order of 10^5 deg K, with a density $N \simeq 10^2 - 10^3$ cm^{-3}. It is suggested that above $5R_e$ the exosphere is not in thermal equilibrium, so that long-range damping cannot occur. (auth)

19645 EXOSPHERIC ELECTRON TEMPERATURES FROM NOSE WHISTLER ATTENUATION. H. B. Liemohn (Boeing Scientific Research Labs., Seattle) and F. L. Scarf. J. Geophys. Research, 67: 1785-9(May 1962).

A recent conjecture that the observed whistler cutoff arises from thermal broadening of the cyclotron resonance was used to evaluate electron temperatures. In the original work, very crude data were analyzed with a modified dispersion relation based on the collisionless Boltzmann equation, and it was concluded that $T \simeq (2.0 \pm 1.0) \times 10^5$ °K at $R/R_e = 4$, geocentric. This thermal analysis has now been applied to new whistler data using each of the assumed density variations and both one- and two-hop interpretations of the data. The most reasonable results for the effective density and temperature at $R/R_e \simeq (4-4.5)$ appear to be $N \simeq (200-700)$ electrons/cm^3 and $T \simeq 2.5 \times 10^5$ °K. (auth)

19646 ELECTROMAGNETIC PROPERTIES OF AN EXPANDING STREAM OF MAGNETIZED PLASMA. C-G. Faelthammar (Royal Inst. of Tech., Stockholm). J. Geophys. Research, 67: 1791-4(May 1962).

The electromagnetic properties of magnetized plasma streams from the sun are discussed on the basis of a model in which the plasma expands radially. The role of the magnetic-inhomogeneity drift for the ejection of streams is briefly mentioned. (auth)

19647 ON THE ALTITUDE AT WHICH SOME SOLAR-FLARE-INDUCED IONIZATION IS RELEASED. D. P. Kanellakos, K. L. Chan, and O. G. Villard, Jr. (Stanford Univ., Calif.). J. Geophys. Research, 67: 1795-1804(May 1962).

During the occurrence of certain solar flares and subflares (about 20 to 25% of those optically observed), the instantaneous frequency of a highly stable, CW, HF signal transmitted obliquely through the ionosphere, over distances of the order of 5000 km, is momentarily changed by a few cycles. The change consists of an increase in the frequency, followed by a decrease and, subsequently, a gradual return toward the original received frequency. The rapidly changing portion of the frequency variation lasts only a few minutes (usually less than 5). In addition, the frequency change varies inversely with the operating frequency and proportionally with the path length. Paths separated by many hundreds of kilometers are simultaneously affected. It is of interest that these pronounced frequency shifts invariably occur prior to the loss of signal characteristic of a short-wave fadeout, and hence could conceivably be used to warn of impending signal loss in modern HF communication systems affording continuous feedback of propagation conditions over the path. In certain cases, however, the flare-induced frequency shift is not followed by a fadeout. The azimuthal angle of arrival of the same signals that have frequency changes during solar flares and subflares also deviates in about one-third of the cases. The fact that a HF wave exhibits bearing deviations signifies that a horizontal gradient of ionization, capable of bending the wave, exists. Electron-density gradients are probably produced as a result of solar-flare-induced ionization, especially at times when the sun's energy falls at a grazing

angle on the path. The angle usually deviated to the south (toward the subsolar point) of the great-circle path for the Puerto Rico-Palo Alto (PR-SU) path during the season at which these measurements were made. These observations of instantaneous frequency and angle-of-arrival changes during solar flares suggest that new ionization is introduced initially somewhere just above the E region, very probably in the height region 120 to 200 km, although even greater heights are possible. This initial ionization may or may not be followed by the generation of ionization in the absorbing D region. The time variation of height at which solar-flare-induced ionization is released suggests that the ionization-producing radiant energy is initially soft, and then hardens as the flare progresses. (auth)

19648 SCATTERING OF RADIATION BY THE FLUCTUATIONS IN A NONEQUILIBRIUM PLASMA. O. Buneman (Stanford Univ., Calif.). J. Geophys. Research, 67: 2050-3 (May 1962).

Distinction is made between low Doppler-shift frequencies governed by ion dynamics and high Doppler-shift frequencies governed by electron dynamics in the theory of plasma fluctuations and of the radar scattering from them. The two spectral ranges are well separated because of the disparity of the masses. The formulas and the justification for each, given for the separate contributions, show how the power shifts from the high-frequency to the low-frequency range (that is, out of the electron resonances into the ion resonances) as the wavelength is increased, and how, eventually, it reaches $T_i/(T_e + T_i)$ of the original level. Curves of power versus inverse wavelength for various temperature ratios are given. (P.C.H.)

19649 SUDDEN COMMENCEMENT HYDROMAGNETIC WAVES AND THE ENHANCED SOLAR WIND DIRECTION. Charles R. Wilson (Univ. of Alaska, College). J. Geophys. Research, 67: 2054-6(May 1962).

From the analysis of 77 sudden commencement (SC) hydromagnetic waves (for 1957 to 1960) at Sitka and College, Alaska, the azimuth of the meridian plane of symmetry separating the two polarization zones was determined to be 25° west of the sun-earth line. The fact that the plane of symmetry is inclined to the west of the sun-earth line is thought to indicate that the solar plasma stream, which generates the SC hydromagnetic waves upon collision with the earth's magnetic field, propagates parallel to the extended solar magnetic field. An analysis of the mechanism for the excitation of transverse hydromagnetic waves shows that the inclination of the normal to the solar plasma shock front 25° west of the sun-earth line, as determined by the symmetry pattern of SC hydromagnetic waves, seems to indicate that the solar plasma responsible for SC magnetic storms is guided, as in polar-cap absorption events and high-energy solar cosmic rays, by the extended solar magnetic field. (P.C.H.)

19650 FIVE-DIMENSIONAL COSMOLOGY AND THE HYPOTHESIS OF NEGATIVELY CHARGED STARS. N. W. Taylor (Univ. of New England, Armidale, [Australia]). Nature, 194: 647-9(May 19, 1962).

V. A. Bailey has suggested that negatively charged stars could exist in a five-dimensional universe and that conservation laws hold exactly in the five-dimensional continuum but not in the four-dimensional continuum. An investigation is made on a statement of the conservation laws, and both of Bailey's suggestions are confirmed. The implications of the results with respect to the expanding model of the universe are discussed. A reply from V. A. Bailey is given. (D.L.C.)

19651 DISTRIBUTION OF ELEMENTS OVER THE SURFACE OF A MAGNETIC STAR. Eberhart Jensen (Sacramento Peak Observatory, Sunspot, N. Mex.). Nature, 194: 668-9(May 19, 1962).

The anomalous abundances and periodic variation of spectra in magnetic stars are discussed and a possible cause is pointed out. This cause comprises a magnetic field that is not strictly homogeneous, and the elements showing the most striking nonuniform distribution in the magnetic stars are the rare earths whose magnetic moments are particularly large. An estimate is made of the forces involved and the resulting scale in the density distribution; for a field of 10^3 gauss, L is calculated to be $\sim 10^{12}$ cm, which is of the order of magnitude of the radius of an A star. (D.L.C.)

19652 COSMOGENIC RARE GAS RATIOS IN IRON METEORITES. David E. Fisher (Cornell Univ., Ithaca, N. Y.). Z. Naturforsch., 16a: 1387-90(Dec. 1961). (In English)

Rare gas abundances in iron meteorites are compared with cross section ratios from high energy bombardments. A meteoritic low-energy flux (below 1 Bev) of about 13 times the high energy flux (above 1 Bev) is found. About half the helium is produced by this low energy flux. (auth)

Cosmic Radiation

19653 (GCA-61-37-A) ATMOSPHERIC PROCESSES. Paul J. Nawrocki and Robert Papa (Geophysics Corp. of America, Bedford, Mass.). July 1961. Contract AF19 (604)-7405. 710p. (AFCRL-595; AD-263459)

Information on upper atmospheric processes is presented. The handbook comprises 13 chapters. Separate abstracts were prepared for 5 of these. Chapters for which no abstracts were prepared are concerned with information on the upper atmosphere, reaction rates, molecular diffusion, atmospheric turbulence, solutions of the continuity equation, energy loss processes of solar corpuscles, geomagnetism, and plasma dynamics. (J.R.D.)

19654 (GCA-61-37-A(Chap.2)) THE SOLAR SPECTRUM AND CROSS SECTIONS FOR PHOTOIONIZATION AND ABSORPTION. (Geophysics Corp. of America, Bedford, Mass.). Chap. 2 of ATMOSPHERIC PROCESSES. 45p.

A review of data and observations concerning solar UV and x ray spectral intensities at 1 to 2000 A is presented. Measurements in the range 100 to 1500 A are emphasized. A review of information on atmospheric photoionization is included. (J.R.D.)

19655 (GCA-61-37-A(Chap.4)) ATOMIC TRANSITION PROBABILITIES. Ali M. Naqvi (Geophysics Corp. of America, Bedford, Mass.). Chap. 4 of ATMOSPHERIC PROCESSES. 53p.

A review is presented concerning the theory for calculating radiative atomic transition probabilities. A summary of results obtained by various workers is included along with new calculations. Atoms of interest in upper atmosphere research include H, N, O, Na, K, Li, Ru, and Cs. (J.R.D.)

19656 (GCA-61-37-A(Chap.9)) GENERATION OF ELECTROMAGNETIC WAVES. (Geophysics Corp. of America, Bedford, Mass.). Chap. 9 of ATMOSPHERIC PROCESSES. 41p.

The generation and effects of electromagnetic waves in the terrestrial atmosphere are examined. The wave effects are discussed in relation to the interaction mode rather than by the nature of the source. (J.R.D.)

19657 (GCA-61-37-A(Chap.10)) TRANSMISSION OF ELECTROMAGNETIC WAVES. (Geophysics Corp. of America, Bedford, Mass.). Chap. 10 of ATMOSPHERIC PROCESSES. 75p.

Techniques for measurements of atmospheric transmission of electromagnetic waves are discussed. Theoretical aspects are considered. (J.R.D.)

19658 (GCA-61-37-A(Chap.11)) COSMIC RAYS. (Geophysics Corp. of America, Bedford, Mass.). Chap. 11 of ATMOSPHERIC PROCESSES. 36p.

A review of information is presented concerning cosmic rays. Observations in this area are interpreted in a manner consistent with the assumption that the universe is finite in extent; finite in the number of fundamental particles, and expanding from a cataclysm at t_0. The particles are grouped according to their nature as cosmic primaries or atmosphere-created secondaries. (J.R.D.)

19659 (TID-15699) A DETERMINATION OF THE VOLUMETRIC RATE OF COSMIC RAY STAR PRODUCTION AT HIGH ALTITUDES USING NUCLEAR EMULSIONS (thesis). Richard Bosseron Reinecke (Vanderbilt Univ., Nashville). June 1953. 34p.

The volumetric rate of cosmic-ray star production at high altitudes was determined. Nuclear emulsions were included in a rocket flight and balloon flight. The emulsions were processed with control plates with identical histories except for the flight, and then microscopically scanned for cosmic-ray stars. Aside from simple electron and proton tracks, the events discovered in the exposed nuclear emulsions fell into four classes: thorium stars, cosmic-ray stars, pi-mu-e decays, and heavy primary tracks. Results are presented in graph form. (M.C.G.)

19660 SPACE RADIATION, ITS NATURE AND PROPERTIES. A. J. Masley and A. D. Goedeke. Aerospace Eng., 21: No. 6, 21-31(June 1962).

A summary of the galactic cosmic radiation discoveries made as a result of International Geophysical Year investigations is presented as well as results of recent measurements in the Van Allen radiation zones and results of a detailed analysis of several major solar cosmic-ray events. The galactic cosmic rays and Van Allen belts appear to offer no real obstacle to space travel for limited time durations. Solar flares present the least predictable hazard. The bibliography contains 70 references. (N.W.R.)

19661 SMALL COSMIC-RAY INCREASES MEASURED AT GROUND LEVEL, SEPTEMBER 3, 1960, JULY 18 AND JULY 20, 1961. B. G. Wilson, D. C. Rose, and Margaret D. Wilson (National Research Council, Ottawa). Can. J. Phys., 40: 540-9(May 1962). (NRC-6750)

Three small increases in cosmic-ray intensity, observed in high counting rate neutron monitors in Canada, are described and the results examined in relation to the impact zone effect. Pronounced impact zone effects were observed during the July 18, 1961, event, the largest of these three increases, while the September 3, 1960, event showed no such effects. Considerations of the state of the interplanetary magnetic fields at these times show that these results are consistent with previous explanations. The sharp rise to maximum of the July 20, 1961, increase would suggest strong impact zone effects, but such conclusions that can be drawn from the limited data and the small magnitude of the increase suggest that it does not conform with the usual pattern. (auth)

19662 ENERGY SPECTRUM OF ELECTRONS IN THE OUTER RADIATION BELT. Wilmot N. Hess (National Aeronautics and Space Administration, Greenbelt, Md.) and John A. Poirier. J. Geophys. Research, 67: 1699-1709 (May 1962). (UCRL-10034)

The equilibrium energy spectrum of electrons in the outer radiation belt is determined by the injection spectrum and the loss processes that operate to remove the electrons or change their energy. The loss processes considered here are ionization energy loss, multiple scattering, and electron-electron scattering; the injection spectra considered are neutron β-decay electrons and monoenergetic electrons of 780 and 20 kev. The problem is treated numerically. The results of the numerical calculation are compared with recent measurements of the outer-belt electron spectrum; it appears that neutron decays produce a reasonable fraction of the outer-belt electrons, but other processes such as acceleration may be important. (auth)

19663 ROCKET OBSERVATIONS OF SOLAR PROTONS DURING THE NOVEMBER 1960 EVENTS. [PART] 2. L. R. Davis and K. W. Ogilvie (National Aeronautics and Space Administration, Greenbelt, Md.). J. Geophys. Research, 67: 1711-16(May 1962).

Rocket observations of solar protons made from Fort Churchill during the November 15, 1960, event are described. Four spectra showing a flattening toward the threshold energy of 4.0 Mev and a rise at even lower energies are given. The decay of intensity was observed to be proportional to $1/T^3$ above an energy of 100 Mev. A plot of the riometer observation against the integral intensity of solar protons above 10 and 100 Mev for eight rocket shots is given. Information concerning the presence of a large intensity of α particles about 2000 UT on November 16 is presented, and the general interpretation of the November 15 event is discussed. (auth)

19664 LOW-ENERGY GAMMA RAYS PRODUCED IN AIR AND IN LEAD BY COSMIC RAYS. J. I. Vette (General Dynamics/Astronautics, San Diego, Calif.). J. Geophys. Research, 67: 1731-9(May 1962).

Measurements were made at 40.5°N geomagnetic latitude of γ rays produced in lead and in air within the energy range 25–1060 kev up to altitudes of 5.4 g/cm^2 by means of balloon-borne scintillation counters. The γ rays of atmospheric origin exhibit a transition curve that peaks at 70 g/cm^2 and is similar to transition curves measured with other omnidirectional detectors. The measurements give a flux of 17.3 photons/cm^2/sec at the peak of the transition curve; extrapolation to the top of the atmosphere gives an albedo of 5.7 photons/cm^2/sec. The spectra of the photons produced in lead and in air are very similar, and the production per gram of lead is found to be about 2.7 times that per gram of air. The power contained in γ rays up to 1 Mev is estimated to be 7% of the incoming power from primary cosmic rays. Because of this large intensity the origin of the photons is difficult to explain in terms of the nucleonic component but is compatible with an explanation based on an electromagnetic origin. (auth)

19665 DOPPLER-SHIFTED CYCLOTRON RADIATION FROM ELECTRONS: A THEORY OF VERY LOW FREQUENCY EMISSIONS FROM THE EXOSPHERE. R. L. Dowden (Ionospheric Prediction Service, Hobart Tasmania, Australia and Univ. of Tasmania, Hobart, Australia). J. Geophys. Research, 67: 1745-50(May 1962).

Cyclotron radiation from electrons in the exosphere spiraling along a line of force away from the observer will appear at a frequency less than the local gyrofrequency. An electron traveling from the observer's hemisphere to the opposite hemisphere will radiate a decreasing frequency until it crosses the equator, and thence an increasing frequency. Propagation conditions and various particle speeds

give frequency-time spectra similar to those observed. A method of scaling electron speeds and the field lines in which they occur from observed data is described. Tests of the theory are discussed. (auth)

19666 SOME NOTES ON COSMIC RADIATIONS AND MAGNETIC FIELDS MEASURED BY PIONEER V. Tatsuzo Obayashi (Arctic Inst. of North America, Washington, D. C.). J. Geophys. Research, 67: 2039-44(May 1962).

An important interaction between solar cosmic rays and magnetic plasma clouds is pointed out by carefully comparing various solar and geophysical data taken during the active life of Pioneer V in space beyond 5,000,000 km from the earth. Major events during the period from March 28 to April 7, 1960 are tabulated. (P.C.H.)

19667 THE MOMENTUM SPECTRUM OF MUONS AT A DEPTH 7.2 kg cm^{-2} UNDERGROUND. M. J. Campbell, H. S. Murdoch, K. W. Ogilvie, and H. D. Rathgeber (Univ. of Sydney). Nuovo cimento (10), 24: 37-51(Apr. 1, 1962). (In English)

The absolute momentum spectrum of muons at a depth of 7.2 kg cm^{-2} of sandstone rock is measured in the range 2 to 200 Bev/c. The spectrometer and the method of analysis are described in detail. The production spectrum deduced from the data, making suitable assumptions about momentum loss, agrees with that obtained from the muon sea level spectrum, as regards both the absolute rate and shape of the spectrum. The use of Geiger counter trays at five levels makes possible the analysis of multiple events. (auth)

19668 THE FLUX OF γ-RAYS AT HIGH ALTITUDES, AND COMPARISON WITH THE MUON FLUX AT SEA-LEVEL. J. Duthie, P. H. Fowler, A. Kaddoura, D. H. Perkins, and K. Pinkau (Univ. of Bristol, Eng.). Nuovo cimento (10), 24: 122-38(Apr. 1, 1962). (In English)

The flux of γ rays and/or electrons having energies of 360 to 5000 Bev is investigated at atmospheric depths between 8 and 450 g/cm^2. The flux of primary γ rays and electrons of $E > 470$ Bev is found to be $<10^{-3}$ of the flux of nucleons above the same energy. The measured energy spectrum of muons at sea level is compared with that deduced from observations on the γ rays. There is agreement between the two estimates of flux if directly produced pions are assumed to be the sole source of both γ rays and muons. An upper limit is placed on the ratio of numbers of K mesons and pions produced in high-energy nuclear collisions. Even at the highest energies investigated (50,000 Bev primary energy), the energy going into creation of K mesons is shown to be much less than that of pions. (auth)

19669 HIGH-ENERGY ELECTRONS OF SOLAR ORIGIN. Peter Meyer and Rochus Vogt (Univ. of Chicago). Phys. Rev. Letters, 8: 387-9(May 15, 1962).

Balloon measurements of electron flux as a function of atmospheric depth were taken on July 22, 1961, following Class 3^+ solar flares on July 18 and 20. Comparison of the measured flux with a typical quiet-day flux yields a spectrum for the electrons produced in the flares, with an average electron flux of $368 \pm 50/m^2 \cdot sec \cdot sr$ in the energy interval from 100 to 1300 Mev. (T.F.H.)

19670 FLUCTUATIONS OF PRIMARY COSMIC RADIATION. E. Waibel (Max-Planck-Institut für Aeronomie, Lindau, Ger.). Z. Naturforsch., 17a: 135-42 (Feb. 1962). (In German)

The frequency of primary α particles, protons, and the total radiation was measured on August 23, 1960, over Lindau (northern Holland) for relatively constant cosmic radiation with a balloon probe, and extrapolation of the radiation intensities of 0 g/cm^2 leads, for the total radiation, to 0.134 ± 0.003 $(cm^2 \text{ sec sr})^{-1}$ and, for α particles with consideration of the fission of heavy nuclei, to 0.0175 ± 0.0006 $(cm^2 \text{ sec sr})^{-1}$. A comparison with the measurements made from 1957 to 1959, particularly on the Forbush effects, leads to the same logarithmic fluctuation factor of 2.1 ± 0.3 with respect to neutron registration at ground level in Lindau both for the total radiation and for the α component. The frequency of the extrapolated α particle amounts, on an average, to 13% of the total radiation. (tr-auth)

19671 ENERGETICHESKIE SPEKTRY I YADERNYE VZAIMODEISTVIYA CHASTITS KOSMICHESKOGO IZLUCHENIYA. (Energy Spectra and Nuclear Interactions of Cosmic Particles). G. S. Saakyan. Erevan, Publishing House of Erevan University, 1960. 114p.

Work performed during 1955 to 1957 includes a detailed mathematical analysis and general formulas for the probability of detecting and recording charged particles, and studies were made of cross sections of nuclear interactions of π mesons and protons in copper and graphite, the energy spectra of cosmic particles (protons and μ mesons) at 3200 m elevation, and nuclear interactions of high-energy nucleons in the atmosphere. 87 references are included. (R.V.J.)

Criticality Studies

19672 (Y-1388) CONCENTRATION OF BORON OR CADMIUM IN U-235 SOLUTIONS FOR $K_\infty = 1$. Fred G. Welfare (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Mar. 20, 1962. Contract W-7405-Eng-26. 21p.

Using high-speed computer techniques, a calculation was made to determine the concentration of homogeneously distributed boron or cadmium required to reduce K_∞ to 1.0 in aqueous solutions of uranyl fluoride (UO_2F_2). It was found that approximately 82 grams of cadmium per liter of solution, or approximately 37 grams of boron per liter of solution, were sufficient to reduce the infinite multiplication factor to 1.0 in highly enriched solutions of optimum concentration. (Optimum concentration, as used here, refers to the optimum for minimum critical geometry, i.e., having hydrogen-to-U^{235} ratio of about 44.) For solutions of lower U^{235} enrichment, the poison required is, of course, lower. In addition, the ratio, density of poison required for $K_\infty = 1$ to density of U^{235} present, was calculated. For highly enriched solutions of optimum moderation this ratio was found to have a value of 0.05 for boron poisoning and a value of 0.15 for cadmium poisoning. (auth)

19673 THE INFINITE NEUTRON MULTIPLICATION CONSTANT OF HOMOGENEOUS HYDROGEN-MODERATED 2.0 wt %-U^{235}-ENRICHED URANIUM. John T. Mihalczo (Oak Ridge National Lab., Tenn.) and Victor I. Neeley. Nuclear Sci. and Eng., 13: 6-11(May 1962).

The infinite medium neutron multiplication factor, k_∞, of a mixture of 92.1 wt % UF_4 and 7.9 wt % paraffin was measured both in the Physical Constants Testing Reactor at the Hanford Atomic Products Operation and in critical experiments at the Oak Ridge National Laboratory. The density of the mixture is 4.5 g/cc and the U^{235} enrichment of the uranium is 2.0 wt %, resulting in an $H : U^{235}$ atomic ratio of 195. The values of k_∞ from the two experiments are 1.216 ± 0.013 and 1.197 ± 0.015, respectively. In the analysis of the critical experiments a two group model was

assumed for the nonleakage probability. The neutron age to thermal was determined from buckling perturbation measurements as 43.1 ± 3.4 cm^2. The critical buckling was measured to be (4344 ± 65) × 10^{-6} cm^{-2}, the bare extrapolation distance 2.7 ± 0.3 cm, and the fast fission factor 1.039 ± 0.004. Within the experimental error, the values of k_∞ from critical experiments at ORNL and from the PCTR at HAPO agree. (auth)

Elementary Particles and Radiations

19674 (JINR-P-858) SPINOVYE SOSTOYANIYA CHASTITS PRI UPRUGOM NUKLON-DEITRONNOM RASSEYANII. (Spin States of Particles in Elastic Nucleon-Deuteron Scattering). B. M. Golovin, R. Ya. Zul'karneev, V. I. Nikanorov, and V. I. Satarov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1961. 15p.

Polarization conditions for elastic N-d scatterings are expressed with scattering amplitude coefficients in pulse approximation, and a method for reducing the amplitude with randomly collected orbits is indicated. (tr-auth)

19675 (TID-15418) PRODUCTION OF HIGH CURRENT ELECTRON BEAMS, ELECTRON GUNS, AND ELECTRON OPTICS OF HIGH CURRENT ELECTRON BEAMS. A Bibliography. Gretchen R. Riese, comp. (Los Alamos Scientific Lab., N. Mex.). Aug. 8, 1957. Contract [W-7405-Eng-36]. 21p. (D-BIB-8)

A bibliography is presented on production of high-current electron beams, electron guns, and electron optics of high-current electron beams. The 60 references covering the period 1938 to 1957 are arranged chronologically. (M.C.G.)

19676 (TID-15688) STUDIES OF DEUTERON BUILD-UP TARGETS FOR NEUTRON PRODUCTION (thesis). Roy Turner Arnold (Vanderbilt Univ., Nashville). June 1956. 43p.

Studies were conducted to find a target material for the D(d,n)He^3 reaction that is relatively inexpensive and does not pose extreme difficulty in usage. The materials studied did not contain deuterium before they were used as targets for the incident deuterons. Accelerated deuterons were allowed to strike target material which was free from surface contamination, and the deuterons were trapped in the material. The materials used were Al, brass, C, Cu, Nb, Pb, Pb-Sn, Ni, Pd, paraffin, Ag, Ta, Th, Sn, Zn, and Zr. The yield for heavy water was determined under the same experimental conditions as the other target materials, and a value of 9.23 × 10^4 neutrons per microcoulomb was obtained. The materials that most nearly approached this value (a factor of 5 lower) were brass, Pb-Sn alloy, Ag, and Ni. There appeared to be no correlation between the yield obtainable from a metal and the metal's affinity for hydrogen. There was some evidence for a relationship between the amount of retention and the half-distances between the centers of neighboring atoms in the crystal lattice. (M.C.G.)

19677 (TID-15698) SCINTILLATION SPECTROMETRY OF LOW ENERGY BREMSSTRAHLUNG (thesis). Richard Jay Raridon (Vanderbilt Univ., Nashville). June 1955. 36p.

Studies were made of the spectrum of an x-ray beam using scintillation and proportional detectors. Methods of obtaining the spectrum are discussed including theoretical calculations, Laplace transformation, and scintillation spectrometry. An absorption curve was obtained with the scintillation spectrometer. Characteristic radiation of tungsten was found to be present to a greater extent than previously supposed. The percentage of characteristic radiation present in the continuous spectrum was found to be 40 to 65%. Results are presented in graphs. (M.C.G.)

19678 (UCRL-10127) SCATTERING OF 310-Mev POSITIVE PIONS BY PROTONS: EXPERIMENTS AND ANALYSIS (thesis). Ernest H. Rogers (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 19, 1962. Contract W-7405-Eng-48. 65p.

The differential cross section for elastic scattering of 310-Mev positive pions on protons was measured at 23 angles between 14 deg and 165 deg in the center-of-mass system. The fractional rms errors were typically 3%. A liquid hydrogen target was bombarded by a beam of 2 × 10^6 pions/sec. The scattered pions were detected by a counter telescope. The data at small angles clearly showed constructive interference between nuclear and Coulomb interactions. A total cross section of 60.0 ± 1.4 mb was measured by attenuation. These data were combined with data on the polarization of the recoil proton, which were taken simultaneously with the cross-section measurements, and a phase-shift analysis was made. This analysis was hampered by the small angular region covered by the polarization data (114 deg to 145 deg), but even this limited amount of information about the polarization proved extremely valuable. It was impossible to obtain an adequate fit to the data in terms of only S- and P-wave phase shifts. However, a very satisfactory fit was obtained when D waves were also included. Moreover, this solution was unique. Only one set of SPD-wave phase shifts agreed with the data. This set was of the Fermi type. When F waves were also included in the analysis, the fit to the data was not improved significantly. However, the errors on the S-, P-, and D-wave phase shifts increased from about ½ deg to around 2½ deg, and additional sets of phase shifts that fit the data arose. The S-, P-, and D-wave phase shifts differed considerably among the various sets, even though the F-wave phase shifts were quite small. (auth)

19679 (UCRL-10130) K^+ NUCLEON INTERACTIONS IN THE MOMENTUM RANGE OF 800 TO 2900 Mev/c (thesis). Victor Cook (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 21, 1962. Contract W-7405-Eng-48. 84p.

Experimental measurements of the K^+-nucleon total cross section in the momentum range between 0.8 and 2.9 Bev/c, and K^+-proton elastic scattering angular distributions at 0.97, 1.17, and 1.97 Bev/c are reported. The K^+-proton and K^+-neutron total cross sections were found to be nearly equal and constant at about 17.5 mb between 1.0 and 2.9 Bev/c. At 0.77 Bev/c both cross sections were significantly lower; the value measured for K^+-proton was 13 mb, and for K^+-neutron was about 15 mb. Phase-shift analyses of the K^+-proton differential cross sections are discussed. Several sets of solutions found at 0.97 and 1.17 Bev/c are given. The angular distribution at 1.97 Bev/c is peaked in the forward direction, indicating the presence of many angular-momentum states. The results of an optical-model analysis of these data are presented. The existing information on K^+-proton total cross sections and experimental values for the real part of the forward scattering amplitude were used in a forward-dispersion-relation calculation to evaluate the residue of the effective pole $\tilde{\Gamma}(\Delta, \Sigma, Y_1^*, Y_0^*)$, and to compare the energy dependence of the real part of the forward scattering amplitude, as predicted by the forward dispersion relations, with the data. (auth)

19680 (UCRL-10171) FURTHER REMARKS ON THE Σ PARITY. Robert D. Tripp, Mason B. Watson, and Massimiliano Ferro-Luzzi (California. Univ., Berkeley.

Lawrence Radiation Lab.). Apr. 13, 1962. Contract W-7405-Eng-48. 11p.

Answers are given to some recent criticisms of the Σ parity determination made at the Lawrence Radiation Laboratory. (auth)

19681 (AEC-tr-5084) SCATTERING OF POLARIZED PROTONS BY A TARGET OF POLARIZED PROTONS. J. Raynal. Translated by Gretchen R. Riese and Nelson Jarmie (Los Alamos Scientific Lab., N. Mex.) from Nuclear Phys., 28: 220-43(1961). 28p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 8113.

19682 ISOBAR APPROXIMATION OF PRODUCTION PROCESSES. S. Mandelstam, J. E. Paton, Ronald F. Peierls, and A. Q. Sarker (Univ. of Birmingham, Eng.). Ann. Phys. (N. Y.), 18: 198-225(May 1962).

The three-particle term in the unitarity relation is approximated by treating pairs of particles as isobars. The method is applied to investigate the (33) resonance contribution to inelastic π-N scattering and to the model for the second π-N resonance proposed. (auth)

19683 MULTIPLE SCATTERING OF LOW ENERGY PIONS IN DEUTERIUM. William M. Frank and Thurman E. Spriggs (Naval Ordnance Lab., Silver Spring, Md.). Ann. Phys. (N. Y.), 18: 226-49(May 1962).

Dinucleon formalism is applied to the scattering of pions on a dinucleon system. The on-the-energy-shell multiple scattering contribution can be found from an integro-differential equation which is solved exactly. The double scattering approximation to the solution is shown to agree with other calculations. (auth)

19684 EXISTENCE OF $\Delta S = -\Delta Q$ LEPTONIC DECAYS AND A MODEL OF WEAK INTERACTIONS ON THE INTERMEDIATE BOSON BASIS. Gyo Takeda (Univ. of Wisconsin, Madison). Ann. Phys. (N. Y.), 18: 310-33(May 1962).

An incorporation of $\Delta S = -\Delta Q$ decays into the theory of weak interactions is discussed. To this end, a model of weak interactions is proposed on the assumption of intermediate vector boson fields of a particular kind. The fields represent two sets of positive, negative, and neutral charged bosons, the two sets being hermitian conjugates. The weak currents coupled to the fields are derived from the invariance of the weak interactions under two sets of gauge transformations, each set forming a Lie group of rank 1 and order 3. Various predictions of the model are consistent with experiment and further ways to test the model are discussed. (auth)

19685 ELECTRON SHOWER CURVES IN LEAD FOR ENERGIES OF 3 TO 40 Bev. Margaret D. Wilson and I. B. McDiarmid (National Research Council, Ottawa). Can. J. Phys., 40: 573-85(May 1962). (NRC-6794)

Electron-photon showers in lead were studied in a multiple cloud chamber at energies up to 40 Bev. The numbers of electrons under various thicknesses of lead were determined by a photometric method combined with scintillator measurements. Experimental shower curves for several energies are given as well as the mean number of electrons at the shower maximum as a function of shower energy. The results are compared with standard shower theory under Approximation A with an assumed low-energy cutoff. (auth)

19686 THE SCATTERING OF π^+ MESONS ON PROTONS IN THE HEITLER-ARNOUS NON-LOCAL THEORY. Jean-Claude Guillot and Yvonne Héno. Compt. rend., 254: 1932-4(Mar. 12, 1962). (In French)

The Heitler-Arnous nonlocal interaction theory is applied to the treatment of the scattering of π^+ mesons on protons. A second-order calculation leads to notable progress with respect to the local theory and to the "cut-off theory." (tr-auth)

19687 CALCULATION OF THE MULTIPLE PRODUCTION OF PARTICLES IN π^-,p INTERACTIONS AT 5 Bev. Roger Laverrière (Institut de Physique Nucléaire, Lyon). Compt. rend., 254: 1975-7(Mar. 12, 1962). (In French)

The statistical theory calculation of the multiple production of particles in π^-,p interactions at 5 Bev was made with the aid of a recently described approximation method. The results show a general satisfactory agreement with experimental data. The effect of "interaction volume" parameters and of resonance states of the π mesons is discussed. (tr-auth)

19688 STRONG INTERACTION OF BARYONS AND κ-CHARGE. Seitaro Nakamura (Tokyo Univ. and Nihon Univ., Tokyo) and Shgeo Hatsukade. Nuclear Phys., 31: 611-27(Apr. 1962). (In English)

An attempt is made to establish an interaction Hamiltonian of baryons that is symmetric in the three-dimensional charge space called N-space, where electric charge is defined as $Q_e = N_3$. In order to describe the strong interaction as well as the weak interaction in the same N-space, strangeness is ignored and a new quantum number is introduced, the κ-charge Q_κ, which enables baryons to be classified into two groups: $Q_\kappa = \frac{1}{2} + \kappa_3 = 1$ for the nucleons and the Ξ-particles ($\kappa_3 = \frac{1}{2}$) and $Q_\kappa = 0$ for the Σ and Λ-particles ($\kappa_3 = -\frac{1}{2}$). These two groups are compared to the proton and neutron in the symmetric meson theory, and certain strong interactions of the Yukawa type between them are considered. In order to give a Hamiltonian symmetric in κ-space and also in N-space (both of which are assumed to be three-dimensional and orthogonal to each other), the existence of sixteen kinds of mesons which mediate the strong interactions among baryons ($\kappa_3 = 1$, $0, -1$, $|\kappa| = 1$; and $\kappa_3 = 0$, $|\kappa| = 0$) are assumed, to each of which there correspond values of the electric charge $Q_e = N_3 = 1, 0, -1; 0$. It is shown that the kaons correspond to mesons with $\kappa_3 = \pm 1$; the strangeness-two mesons to those with $\kappa_3 = 0$ ($|\kappa| = 1$); and pions to those with $\kappa_3 = 0$ ($|\kappa| = 0$). For the Hamiltonian no special symmetry is assumed in the Lorentz space, so that the original symmetry in the speculated charge spaces cannot in general be maintained if the diversity of the Dirac-operators and of the intrinsic parities of mesons is to be upheld. Thus a so-called "fragile" symmetry is proposed, which would unite higher symmetry in the pion-baryon, kaon-baryon, and D-meson-baryon couplings at the cost of partially violating the original symmetry in $\kappa-$N spaces. It is shown that conservation of κ-charge and doubling the number of kaons (K-kaons and L-kaons) permits an explanation to be made of the experiments that can be complementarily explained by the strangeness rule. From the κ-charge selection rule, the existence of Ξ-hyperfragments is expected, which from the strangeness rule alone should decay instantaneously. (auth)

19689 NEUTRON-NEUTRON SCATTERING LENGTH FROM FINAL STATE INTERACTIONS. R. J. N. Phillips (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 31: 643-8(Apr. 1962). (In English)

A way is shown to extract n-n correlation effects, and hence the low energy n-n phase shift, directly from the energy spectrum of particle c in a reaction $a + b \rightarrow c + 2n$. Correlation effects may also be sought in the n spectrum, but this seems a less favorable approach unless two particles are measured in coincidence. (auth)

19690 K* AND LEPTONIC DECAYS OF K MESON AND Λ HYPERON. Fayyazuddin (Imperial Coll. of Science and Tech., London) and Riazuddin. Nuclear Phys., 31: 649-56 (Apr. 1962). (In English)

The effect of the (Kπ) resonance (K*) on K_{e3} and Λ hyperon β-decay is considered. In particular the π spectrum in K_{e3} decay is calculated by considering two probable spin assignments of K*(0 or 1). The π spectrum is not sensitive to the spin of K*. Form factors for Λ hyperon β-decay are also calculated for the two cases. Remarks about the conserved-vector-current hypothesis in these decays are made. (auth)

19691 ELASTIC PROTON-PROTON SCATTERING AT HIGH ENERGIES. INTERPRETATION OF EXPERIMENTAL RESULTS AT 8.5 Gev. R. C. Kumar (University Coll., London). Nuovo cimento (10), 24: 9-20(Apr. 1, 1962). (In English)

The optical model, in a general form, is used to analyze the experimental data on elastic proton-proton scattering at 8.5 Bev. Different models for the two-nucleon potential, excluding spin-dependent potentials, are tried; it is found that each model fits the experimental data equally well. The rms radius of the proton is approximately the same in each model; the value obtained is approximately 1.0 or 1.2 fermi depending on whether no real potential or the maximum possible value of the real potential is included in the calculations. The maximum value of the real potential consistent with the experimental total and elastic cross sections is approximately two-thirds of the corresponding imaginary part. (auth)

19692 INELASTIC PION-NUCLEON INTERACTIONS AT 7.3 Gev IN EMULSION. G. Bozóki, E. Fenyves, A. Frenkel, E. Gombosi, and P. Surányi (Central Research Inst. of Physics, Budapest). Nuovo cimento (10), 24: 29-36(Apr. 1, 1962). (In English)

The angular distribution of secondary pions produced in pion-nucleon collisions at 7.3 Bev was investigated. The angular distribution was found to be nearly symmetric in the π-π center-of-mass system for events of small multiplicity (n = 1 or 2) and significantly asymmetric for higher multiplicities (n ≥ 3). Assuming events of small and high multiplicity to be π-π and π-core collisions, respectively, the radius of the nucleon core was estimated to be $\leq 0.7 \times 10^{-13}$ cm. (auth)

19693 UNIVERSAL FERMI INTERACTION AND THE NEUTRINO FLIP. W. Królikowski (Inst. for Advanced Study, Princeton, N. J.). Nuovo cimento (10), 24: 52-72 (Apr. 1, 1962). (In English)

A form of the universal Fermi interaction (UFI) is proposed, which alloys for the "neutrino flip" and at the same time leads to damped leptonic hyperon decays. Rates for leptonic Λ and Σ^- decays are diminished compared to the Feynman-Gell-Mann theory by factors $^1/_3$ and $^2/_3$ respectively. This form is not inconsistent with the status of the so-called "unwanted" leptonic weak processes. The considered interaction displays the correspondence between baryons and leptons expressed by $\nu \rightleftharpoons \Lambda$; $e^- \rightleftharpoons Z$, $\nu' \rightleftharpoons Y$, $\mu^- \rightleftharpoons \Xi$, where Λ, Z, Y, Ξ are baryon doublets and ν and ν' are two different neutrinos. A formal three-dimensional euclidean space called "weak isospace" and a formal four-dimensional space denoted by Ω can be defined, if certain four-component baryon and lepton fields are required to be Dirac-like spinors in these spaces. The weak isospace is an euclidean subspace of Ω. The proposed UFI is invariant under reflections in the Ω space, and under rotations in the three-dimensional weak isospace. There are analogies between properties of the proposed interaction in the weak isospace and the electromagnetic Pauli interaction in the ordinary space. (auth)

19694 PION PRODUCTION IN HYPERON-NUCLEON COLLISIONS. G. Bhamathi, S. Indumathi, T. K. Radha, and R. Thunga (Inst. of Mathematical Sciences, Madras). Nuovo cimento (10), 24: 87-91(Apr. 1, 1962). (In English)

The process $\Sigma^- + p \rightarrow \Sigma^0 + p + \pi^-$ is analyzed by the Chew-Low extrapolation method. The final-state interactions arising from the possible $\pi^- p$ and $Y\pi$ resonances are also incorporated. (auth)

19695 DEPENDENCE OF MØLLER SCATTERING ON INITIAL AND FINAL POLARIZATIONS OF ELECTRONS. Sasabindu Sarkar (Indian Assn. for the Cultivation of Science, Calcutta). Nuovo cimento (10), 24: 139-44 (Apr. 1, 1962). (In English)

A general expression is derived for the Møller scattering of electrons, taking into consideration any polarization states of both the initial and final electrons. The expression is found to be very lengthy; a considerable simplification takes place for the special case in which the initial electrons are polarized perpendicular to the plane of scattering and the final electrons are longitudinally polarized. (auth)

19696 ON THE INTERACTION OF ELEMENTARY PARTICLES IN VIEW OF THE EXTENDED PARTICLE MODEL. [PART] I. T. Gotô (Università, Naples). Nuovo cimento (10), 24: 156-69(Apr. 1, 1962). (In English)

A method for introducing the interactions of extended particles is studied. The method is a relativistic extension of the pseudo-potential method of the nonrelativistic many-body problem with hard-core interaction. A difficulty that occurs in the treatment of the relativistic extended particles may be avoided by the use of suitable boundary conditions. A form of interaction is found, starting from a boundary condition corresponding to the nonrelativistic rigid sphere. (auth)

19697 PROTON-ANTIPROTON ANNIHILATION INTO ELECTRONS, MUONS AND VECTOR BOSONS. A. Zichichi (CERN, Geneva), S. M. Berman, N. Cabibbo, and R. Gatto. Nuovo cimento (10), 24: 170-80(Apr. 1, 1962). (In English)

Considerations on the rather rare annihilation channels of the proton-antiproton system are studied. The two-electron mode is studied as a means of investigating the electromagnetic structure of the proton for time-like momentum transfers. The two-muon mode is studied and compared with the two-electron mode to investigate whether the muon behaves like a heavy electron for large time-like momentum transfers. The existence of weak vector bosons is investigated by means of the modes $p + \bar{p} \rightarrow B + \bar{B}$ and $p + \bar{p} \rightarrow B + \pi$. Although no precise theoretical predictions can be made, estimates indicate that the cross section for these four channels could be roughly of the same order of magnitude. (auth)

19698 PARITY CONSERVATION IN $\Sigma^0 \rightarrow \Lambda + \gamma$. N. Byers (Univ. of California, Los Angeles) W. E. Humphrey, A. H. Rosenfeld, and R. R. Ross. Nuovo cimento (10), 24: 184-5(Apr. 1, 1962). (UCRL-10027) (In English)

The polarization of the Λ produced by unpolarized Σ^0 decay $\Sigma^0 \rightarrow \Lambda + \gamma$ is studied, in order to determine the degree of parity nonconservation in the decay. Events are studied in which the produced Λ decays by $\Lambda \rightarrow \pi^- + p$, and the $A\pi^-$ angular correlations for these decays are fitted to an expression of the form $A + B\cos\Theta$. For 382 events, it is found that $B/A \simeq 0.09 \pm 0.09$. If B/A were zero, that is, if the Λ were completely unpolarized, it

could be concluded that parity is completely conserved in the Σ^0 decay. As a result of the B/A value observed, it is concluded that parity is conserved to within the experimental precision (about 10%). (T.F.H.)

19699 PAIR PRODUCTION AS AN ANALYSER OF CIRCULAR POLARIZATION OF γ RAYS FROM NEUTRAL PARTICLE DECAYS. Haakon Olsen (Norges Tekniske Hogskole, Trondheim, Norway) and L. C. Maximon. Nuovo cimento (10), 24: 186-9(Apr. 1, 1962). (In English)

It is shown that the circular polarization of gamma photons may be calculated from the left-right asymmetry in pair production on heavy nuclei. The left-right asymmetry of electron emission with respect to the positron production plane is used as the criterion for determining the photon polarization. The method has a large efficiency in that both the pair-production cross section and its polarization dependence are large. Experimental applications of the method are suggested. (T.F.H.)

19700 ON THE INTERACTION OF ELEMENTARY PARTICLES IN VIEW OF THE EXTENDED PARTICLE MODEL. II. COVARIANT FORMULATION. T. Gotô (Università, Naples). Nuovo cimento (10), 24: 193-8 (Apr. 1, 1962). (In English)

Covariant methods are used to develop a covariant formulation for representing elementary-particle interactions, in the extended-particle model of quantized field theory. The formulation is valid for many-body systems. It is shown that the Dirac "many-time" theory and the Fock second quantization method lead directly to the desired covariant formulation. The development of this covariant formulation by non-covariant means is also discussed. (T.F.H.)

19701 THREE PION WAVE FUNCTIONS. Ziro Koba (Inst. for Nuclear Research, Warsaw). Phys. Letters, 1: 34-5(Apr. 15, 1962).

A complete set of orthonormal wave functions is presented for three free pions, with definite isospin, total linear momentum, total angular momentum, and parity in the center-of-mass system. The Bose statistics are satisfied, and derivations are made from classification of states by effective angular momentum. (L.N.N.)

19702 REMARKS ON THE pp ELASTIC SCATTERING DIFFERENTIAL CROSS SECTIONS IN THE 1–9 Gev REGION. E. Marquit (Univ. of Warsaw). Phys. Letters, 1: 41-3(Apr. 15, 1962).

Evaluation methods for p-p elastic differential cross sections are examined. Consideration is given in terms of the center-of-mass system energy-normalized cross sections. Cross-section behavior is summarized. (L.N.N.)

19703 UNITARY SYMMETRY OF STRONG INTERACTIONS. C. A. Levinson, H. J. Lipkin, and S. Meshkov (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 1: 44-9(Apr. 15, 1962).

Experimental implications of the octet and Sakata model classification schemes for elementary particles are considered. Reaction amplitudes and observed resonances are discussed. Invariance of strong interactions with respect to the 3-dimensional unitary group, U3, is assumed. The meson-baryon systems, the resonances, and the consequences of R symmetry are examined. (L.N.N.)

19704 STRANGE PARTICLE SPECTROSCOPY. J. P. Dowell, W. Koch, B. Leontic, A. Lundby, R. Meunier, J. P. Stroot, and M. Szeptycka (CERN, Geneva). Phys. Letters, 1: 53-6(Apr. 15, 1962).

Higher hyperon resonances were investigated using a counter technique capable of giving precise information on the mass, width, and differential yield. A search for resonances in the system Y^- having isotopic spin 1 or 2 was conducted by detecting K^+ mesons in the reaction $\pi^- + p \rightarrow Y^- + K^+$. Results are presented in graphical form. (L.N.N.)

19705 ENERGY MEASUREMENTS OF THE 2p–1s TRANSITIONS IN μ-MESONIC ATOMS. P. Brix (Technische Hochschule, Darmstadt, Ger.), R. Engfer, U. Hegel, D. Quitmann, G. Backenstoss, K. Goebel, and B. Stadler. Phys. Letters, 1: 56-8(Apr. 15, 1962).

Measurements of μ-mesonic x-ray energies for selected elements from S to Bi were performed. Special attention for $Z < 30$, where data indicated radii considerably smaller than obtained by electron scattering, was given. Results using muons were compared with those using electrons as probes for nuclear electromagnetic properties. Efforts were concentrated on comparison of μ-mesonic x rays with nearby γ lines of radioisotopes and determination of precise energy differences for mesonic x rays of similar energies. (L.N.N.)

19706 THE SPINS AND LIFETIMES OF THE LIGHT HYPERNUCLEI. R. H. Dalitz and G. Rajasekharan (Univ. of Chicago). Phys. Letters, 1: 58-60(Apr. 15, 1962).

It is shown that calculations of the ${}_\Lambda T$ lifetime in the events $K^- + He^4 \rightarrow \pi^- + p + {}_\Lambda T$, ${}_\Lambda T \rightarrow \pi^- + He^3$ (C. Melitzer, et. al., Bull. Amer. Phys. Soc., 1: 49(1962)) are compatible with the observed value if $J = \frac{1}{2}$ holds for ${}_\Lambda T$, a spin configuration consistent with $J = 0$ for ${}_\Lambda H^4$. Also discussed are the lifetime of ${}_\Lambda H^4$ and the large π^0/π^- ratio in ${}_\Lambda He^4$ decay, which may be understood for $J = 0$ and which add weight to the conclusion that the ${}^1S_0$ Λ–N interaction is more attractive than the ${}^3S_1$ Λ–N interaction. (L.N.N.)

19707 ON THE POSSIBILITY OF STRANGENESS-VIOLATING $\Delta S = 4$ TRANSITIONS IN STRONG INTERACTIONS. H. J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 1: 68(Apr. 15, 1962).

It is suggested that the isobaric parity I^U may be a more basic physical quantity than the quantum number U or the strangeness S. Under this assumption, S is defined only modulo 4, so that the selection rule for S becomes $\Delta S = 4n$ (n = any integer). Several reactions having $\Delta S = \pm 4$ are given as examples, whose observation could verify the original suggestion. (T.F.H.)

19708 PIONIC DECAY OF HYPERONS IN THE POLE APPROXIMATION. Akihiko Fujii (Frascati National Lab., Italy). Phys. Letters, 1: 75-7(May 1, 1962).

A model utilizing the pole approximation is presented that correlates the pion-decay rates and asymmetry parameters of the Σ^+, Σ^-, and Λ^0 hyperons. For strong interactions, the hyperon-pion and hyperon-kaon couplings are assumed to be identical and charge-independent. The effects of the 885-Mev Kπ resonance are also taken into account. (T.F.H.)

19709 SPIN OF $\eta(\zeta)$-MESON AND DECAY MODES OF η- AND ω-MESON. S. Hori, S. Oneda, S. Chiba, and H. Hiraki (Kanazawa Univ., Japan). Phys. Letters, 1: 81-3 (May 1, 1962).

It is proposed that ρ- and ω-meson decays via η and ζ mesons, respectively, may be used to determine the spins of the η and ζ mesons. Decay processes that are allowed for η (or ζ) spin = 1 and forbidden for spin 0 are discussed. The decay rates and branching ratios for the decays $\eta \rightarrow 3\pi$, $\eta \rightarrow$ neutrals, $\omega \rightarrow 3\pi$, $\omega \rightarrow$ neutrals, and $\eta \rightarrow \pi^+ + \pi^- + \gamma$ are calculated, assuming either spin 1^- or 0^- for the η meson. The neutral decay products may be either 2γ or $\pi^0 + \gamma$. The decay rate calculations are not sufficient to determine the η spin. (T.F.H.)

19710 A DOUBLET SYMMETRY SHARED BY STRONG AND WEAK INTERACTIONS. Akihiko Fujii (Frascati National Lab., Italy). Phys. Letters, 1: 91-2(May 1, 1962).

It is shown that for the amplitudes for decays $Y \to N\pi$, $\sqrt{2}(\Lambda^0 \to p\pi^-) = (\Sigma^+ \to n\pi^+) + (\Sigma^- \to n\pi^-)$. This relation is proved by assuming that the origin of non-leptonic weak processes is the strangeness-violating process $B^+ \to B^+ + K$, where B^+ is a baryon doublet, and that the baryon masses are degenerate. It is shown that the weak-interaction and doublet-approximation strong-interaction Hamiltonians are both invariant under a certain class of operations, and the original amplitude relation is shown to result from these invariances. (T.F.H.)

19711 A DYNAMICAL SCHEME FOR MESON-BARYON INTERACTIONS BASED ON SU_3 SYMMETRY. R. E. Cutkosky, J. Kalckar, and P. Tarjanne (NORDITA, Copenhagen). Phys. Letters, 1: 93-6(May 1, 1962).

The forces between baryons and mesons that are predicted by SU_3 symmetry (i.e., "unitarity symmetry") are investigated, in order to determine possible assignments of meson-baryon scattering resonances to SU_3 multiplets. Both vector and pseudoscalar mesons are considered. The triplet and octet models for representing the SU_3 multiplets are outlined. The properties of physical particles (Y^*, N^*, etc.) are compared with the predictions of the triplet and octet models. (T.F.H.)

19712 DECAY OF THE ω AND η MESONS. Claude Itzykson (Centre d'Études Nucléaires, Saclay, France), Maurice Jacob, Frédéric Pham, and Wolfgang Alles. Phys. Letters, 1: 96-7(May 1, 1962).

A lowest-order perturbation theoretical treatment is given of the decay of the 3-pion resonances, ω and η, assuming a strong but very short-range interaction. It is assumed that the most important intermediate state for these particles is the $N\bar{N}$ pair; the basis of this assumption is the very strong ω production in $p\bar{p}$ annihilation. The decay rates are calculated for $\omega \to 3\pi$, $\omega \to \pi^0\gamma$, $\eta \to 3\pi$, $\eta \to \gamma\gamma$, and $\eta \to \pi^+\pi^-\gamma$. (T.F.H.)

19713 SPIN STRUCTURE OF THE MESON–NUCLEON AND NUCLEON–NUCLEON SCATTERING AMPLITUDES AT HIGH ENERGIES. V. N. Gribov (Leningrad Inst. of Physics and Tech.) and I. Ya Pomeranchuk. Phys. Rev. Letters, 8: 412-14(May 15, 1962).

The vacuum pole in meson–nucleon and nucleon–nucleon (N-N) scattering amplitudes is studied, in order to analyze the spin structures and interrelationships of these amplitudes. It is found that at zero momentum transfer, for both the total and spin-averaged differential elastic scattering cross sections, $\sigma_{\pi\pi}\sigma_{NN} = \sigma^2_{\pi N}$ and $\sigma_{K\bar{K}}\sigma_{NN} = \sigma^2_{KN}$. It is further found that polarization effects vanish in high-energy meson–nucleon scattering; that spin correlations between the different particles are absent in N-N and N-$\bar{N}$ scattering; and that the spin-flip of polarized particles or targets at fixed momentum transfer is the same for π-N, K-N, N-N, and N-$\bar{N}$ scattering. (T.F.H.)

19714 DALITZ PLOT FOR THE DECAY $\eta \to \pi^+\pi^-\pi^0$. G. Barton and S. P. Rosen (Clarendon Lab., Oxford). Phys. Rev. Letters, 8: 414-17(May 15, 1962).

The characteristics of the Dalitz plots for the two simplest Feynman graphs for $\eta \to 3\pi$ are deduced, assuming that the reaction proceeds through a 2ρ intermediate state. One of the graphs, in which a virtual gamma ray is exchanged between the ρ mesons, is found to be dominant from the viewpoint of the Dalitz plot. It is shown that the momentum and isospin dependence of the decay $K \to 3\pi$ is similar to that deduced for $\eta \to 3\pi$ if it is assumed that the K decay proceeds through a single-π intermediate state. (T.F.H.)

19715 ξ-η DEGENERACY. Marc H. Ross (Indiana Univ., Bloomington). Phys. Rev. Letters, 8: 417-18 (May 15, 1962).

The possibility is noted that the η^0 meson might be identified as the ξ^0 (the neutral component of the ξ meson). Various observations of spins, parities, decay branching ratios, and selection rules that support this proposal are enumerated. Reactions that might verify the proposal are presented. (T.F.H.)

19716 THE PROTON-PROTON SPIN-ORBIT INTERACTION AND THE REPULSIVE CORE. D. W. L. Sprung (Univ. of Birmingham, Eng.). Proc. Roy. Soc. (London). A267: 244-55(May 8, 1962).

It is assumed that the phenomenological proton-proton spin-orbit force arises as a "Thomas term" in the Schrodinger equation, associated with the repulsive core. Since the potentials involved are very strong, the usual derivations are inadequate. The problem is formulated as the scattering of two Dirac particles interacting via a truncated potential which couples only positive energy states. For mathematical simplicity a one-body problem is introduced. An iterative method of solution is carried out to second order in the case of a square repulsive core potential. The method is found to converge. The phase shifts show splitting of the type expected from the Thomas-term assumption. (auth)

19717 SEPARATION SCHEME FOR HIGH ENERGY PARTICLES BY DIFFERENTIAL ENERGY LOSS AND MOMENTUM ANALYSIS. S. Marcowitz and L. Ratner (Argonne National Lab., Ill.). Rev. Sci. Instr., 33: 552-4 (May 1962).

A simple, low cost separation scheme using differential energy loss is described. The expected parameters of the ANL-ZGS secondary beams provide a framework for the design of a $\bar{P}$, K^- beam at 6 Bev/c for bubble chamber use. Magnet stabilities of the order of 0.01% are required. The π^-, $\bar{P}$, K^- ratio at the chamber is about 1 : 8 : 8 with 3.2 $\bar{P}$ and 3.0 K^- per pulse for a ±0.25% initial momentum "bite." A calculation is also made for a 50-Bev/c beam to show that it seems feasible to use this method at energies higher than any that have hitherto been produced. (auth)

19718 AXIOMATICAL APPROACH IN QUANTUM FIELD THEORY AND THE SYMMETRY OF ELEMENTARY PARTICLES. Yu. V. Novozhilov and E. D. Trifonov. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 5-10(1961). (In Russian)

It is shown that from the invariance of the analytically continued Wightman functions under the complex Lorentz group, it follows that a physical theory is invariant under additional symmetry groups R_1^3 and R_2^3. The group R_1^3 is identified with the four dimensional isospin group. (auth)

19719 HARTREE-FOCK METHOD AS A METHOD OF PARTIAL SUMMATION OF DIAGRAMS AND ITS NATURAL GENERALIZATION. V. V. Tolmachev. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 11-19(1961). (In Russian)

Equations derived by partial summation of the diagrams are shown to be equivalent to the equations of the temperature version of the Hartree-Fock method. (auth)

19720 ON CALCULATION OF THREE-BODY FORCES IN THREE-NUCLEON PROBLEM. Yu. P. Shcherbin. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 20-7(1961). (In Russian)

The question of the importance of three-body forces and

the method of variational calculations are considered in connection with the three-nucleon bound state problem. The part of three-nucleon forces, which corresponds to the static potential decreasing as $\exp-(x_i + x_j)$ when the distances x_i, x_j between nucleons tend to infinity, is studied. Matrix elements of this potential are calculated between the angular and spin-isospin parts of the triton wave functions. The method of variational calculations, which gives better results than the ordinary variational method when applied to deep and short range potentials, is proposed. (auth)

19721 MAJORIZATION OF FEYNMAN'S DIAGRAMS FOR THE PROCESSES INVOLVING STRANGE PARTICLES. I. A. Drabkin and Yu. A. Yappa (J. A. Jappa). Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 28-36 (1961). (In Russian)

Some general statements, which essentially simplify the majorization of Feynman's diagrams, are formulated. A method of application of these results to the majorization of diagrams with strange particles is given. (auth)

19722 GENERALIZATION OF BOLTZMANN COLLISION INTEGRAL TO THE INELASTIC COLLISIONS AND REACTIONS. A. V. Luk'yanov. Vestnik Moskov Univ., Ser. III, No. 6, 20-4(1961). (In Russian)

An expression was derived for the rate of distribution function variation caused by inelastic collisions in reacting system. (tr-auth)

19723 THE MOTION OF THE POLARIZATION VECTOR OF A DIRAC PARTICLE IN THE MACROSCOPIC ELECTROMAGNETIC FIELD. H. J. Meister (Universität, Munich). Z. Physik, 166: 468-76(1962). (In German)

The equations of motion of the polarization are derived for a relativistic Dirac particle that has an anomalous magnetic moment and an intrinsic electric dipole moment and moves in a macroscopic electromagnetic field. This is done by starting from the well known motion of the polarization in the rest system and using relativistic kinematics. The general results are discussed for some special fields. (auth)

Neutron Physics

19724 (AFCRL-573) FLUX DISTRIBUTION AND CADMIUM RATIOS OF WATER-MODERATED NEUTRONS PRODUCED BY THE $Li^7(p,n)Be^7$ REACTION. L. F. Lowe and E. A. Burke (Air Force Cambridge Research Center. Electronic Material Sciences Lab., Bedford, Mass.). July 1961. 8p. (AD-265447)

Measurements were made of the flux distribution and Cd ratios of water-moderated neutrons produced in a thick Li target by the $Li^7(p,n)Be^7$ reaction. A 3-Mev Van de Graaff generator (model KN) was used as the source of high energy protons. The moderator consisted of a $1.0 \times 1.25 \times 1.5$ ft Al tank with a water level maintained at 12 in. Pure Au 1-mg samples were used as neutron detectors. The flux rose from 1.82×10^6 n/sec/cm^2/μa at the wall adjacent to the Li target to a maximum value of 3.37×10^6 n/sec/cm^2/μa at one in. along the target axis; it then decreased to 2.29×10^6 n/sec/cm^2/μa at 2.5 in. from the target. Similar results were found along other axes, displaced vertically and horizontally from the target axis, though lower in magnitude. The Cd ratio increased from 3.65 at the target wall to 8.8 at 1.8 in., decreasing slightly to 6.7 at 2.5 in., also along the target axis. (auth)

19725 (SCR-467) COMMENTS ON THE QUANTITATIVE MEASUREMENT OF HIGH-ENERGY NEUTRONS EMITTED FROM A PULSED SOURCE. J. C. Belote (Sandia Corp., Albuquerque, N. Mex.). Jan. 1962. Contract [AT(29-1)-789]. 76p.

After a brief discussion of neutrons, neutron sources, and neutron detection, the problems involved in evaluating scintillation detectors were considered. Extensive appendixes present related data. (auth)

19726 (TID-15645) GREULING-GOERTZEL CALCULATIONS IN HEAVY WATER (thesis). Robert J. Mack (Michigan. Univ., Ann Arbor). Aug. 14, 1959. 34p.

The Greuling-Goertzel approximation was applied to the calculation of neutron slowing down in heavy water in the B_1 and P_1 approximations. Numerical calculations of the flux and non-escape probability assuming constant cross sections indicated the "inconsistent" G-G B_1 approximation to be the most favorable. Existing machine codes can readily be modified to this method. (auth)

19727 (TID-15664) SYNTHETIC METHOD SOLUTION OF THE NEUTRON TRANSPORT EQUATION (thesis). Harold John Kopp (California. Univ., Berkeley). [1962]. 148p.

A residue iteration solution method (the synthetic method) for the neutron transport equation considering isotropic scattering and energy degradation is presented. Properties of the transport equation and its solution are established. Error estimates and the uniqueness of the solution are discussed. Comparison and refinement of existing approximate solution methods for the neutron transport equation can be accomplished within the framework of the synthetic method. Some formal extensions to a wider class of transport problems are indicated. The facility of the synthetic method to solve problems is illustrated by two sample calculations. The first of these is the solution to a heretofore unsolved slowing-down problem in a slab geometry. Numerical results are included along with precision bounds so that this serves as a standard for approximate calculations. A second sample calculation exhibits a comparison of the solution by the synthetic method (accurate to more than 0.0001%) with the P_1-, P_3-, and P_5-approximations for monoenergetic neutrons experiencing isotropic scattering in a slab geometry. Both examples demonstrate the importance of reference calculations and comparisons. The refinement aspects of the method are also illustrated by a generalization of the P_1-approximation (the K_1-approximation) for isotropic scattering media. The sample calculations indicated that the residue iteration method has considerable potential as a practical computing method for isotropic scattering problems. (auth)

19728 (XDCL-59-2-7) THE CALCULATION OF NEUTRON SPECTRA. J. W. Haffner (General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio). Jan. 9, 1959. Contract [AT(11-1)-171]. 22p.

Starting from the integral form of the Boltzmann transport equation, various techniques used to obtain solutions are discussed. The application of these techniques to the calculation of neutron spectra in reactor shields is presented. The dependence of the results on the parameters involved, and their limitations, are considered. (auth)

19729 STUDY OF THE NEUTRON DECAY. Yu. A. Prokof'ev and P. E. Spivak. Atomnaya Energ., 12: 278(Apr. 1962). (In Russian)

The free neutron may be considered as the simplest β-active "nucleus"; its study is of special interest because the exact values of the nuclear matrix elements are known and the theoretical results may be conveniently compared with experimental data. Such investigations have been carried out by groups in the United States, Canada, and the

Soviet Union using thermal neutron beams. After the first approximate values the authors obtained a value of 12.0 ± 1.5 min for the half life of the neutron, while Robson obtained 12.8 ± 2.8 min while also determining the spectrum of decay electrons. These values agreed well with theoretical predictions. The constant was also investigated by determining the electron-neutrino correlation in the β decay of the neutron. The Soviet team showed that the correlation curve agrees well with the predicted values. The G_A/G_V ratio which characterizes the axial-vectorial and vectorial interaction probabilities was derived from the half life of the neutron. More recent results of very precise experiments indicated a neutron half life of 11.7 ± 0.3 min and a G_A/G_V ratio equal to 1.20 ± 0.04. (TTT)

19730 NEUTRON SPECTRA OF A MIXTURE OF TWO NON-INTERACTING GASES HEATED TO DIFFERENT TEMPERATURES. O. B. Moskalev. Atomnaya Energ., 12: 279-82(Apr. 1962). (In Russian)

The motion of the nuclei of the moderating medium plays an important role for solving problems involving thermal reactors. This medium is considered as having only scattering and no absorbing properties. An infinite space filled with 2 monatomic gases which do not react with each other and which are heated to different temperatures is considered. Near a mixture of heavy gases the neutron spectrum follows a Maxwellian distribution determined by the average temperature, the average logarithmic energy loss, and the macroscopic scattering cross section. It is shown that even in the case of light scattering nuclei, kept at different temperatures, the neutron spectrum presents a Maxwellian distribution. (TTT)

19731 SOME RESULTS OF THE MEASUREMENT OF DIFFUSION PARAMETERS OF ORGANIC LIQUIDS BY THE PULSE METHOD. L. N. Yurova, S. B. Stepanov, V. V. Okorokov, and E. I. Kudryashov. Atomnaya Energ., 12: 331-2(Apr. 1962). (In Russian)

The diffusion parameters of diphenyl, $C_{12}H_{10}$, and of isopropyl diphenyl, $C_{15}H_{16}$, were measured by the pulse method; the experimental interval ranged for the first liquid from 100 to 250°C and for the second one from 18 to 250°C. The assembly consisted of a cylindrical tank provided with a Cd piston the vertical displacement of which could be used to change conveniently the geometrical parameters of the system. The moderator above the piston served as a supplementary fast neutron source. From the values of the diffusion coefficient the value of $\bar{\lambda}_{tr}$ was determined for every temperature, assuming a Maxwellian thermal neutron system. The $\bar{\lambda}_{tr} = f(v_0)$ relationship was treated by the least-squares method and yielded the following values: for diphenyl $\bar{\lambda}_{tr} \sim v^{0.33 \pm 0.03}$; for monoisopropyl diphenyl $\bar{\lambda}_{tr} \sim v^{1.58 \pm 0.11}$; for Dowtherm $\bar{\lambda}_{tr} \sim v^{0.82 \pm 0.08}$. In spite of the structural similarity of the organic materials studied, the dependence of $\bar{\lambda}_{tr}$ on the neutron velocity varies considerably, indicating that the neutrons are thermalized to a different extent in these materials. Deviation from the Maxwellian spectrum is the smallest in the case of diphenyl. Calculated values of the diffusion coefficient of diphenyl agree well with experimental results but no such agreement was noticed in the case of the other two materials. (TTT)

19732 SOME CONVENIENT REPRESENTATIONS FOR FISSION-NEUTRON DISTRIBUTIONS IN AIR. R. L. French (General Dynamics, Fort Worth, Tex.). Health Phys., 8: No. 3, 299-304(June 1962).

An analysis of Monte Carlo results for fission-neutron scattering in air has revealed that, for slant ranges of from 500 to 2000 yd, the angular distribution (dose per unit solid angle as a function of angle β measured from the source-receiver axis) of the scattered neutron dose from a point isotropic source may be approximated by $dD_s/d\Omega = a + be^{-c\beta}$. This expression, coupled with an exponential expression for the total scattered dose as a function of range, permits a simple and convenient approach to many dosimetry and shielding problems which require detailed angular and spatial distribution data. The validity of the Monte Carlo data considered in the analysis has been demonstrated by comparison with measured data from weapons tests. (auth)

19733 AN EXPRESSION FOR THE NEUTRON BLACKNESS OF A FUEL ROD AFTER LONG IRRADIATION. Hisao Yamakoshi (Transportation Technical Research Inst., [Japan]). Nippon Genshiryoku Gakkaishi, 4: 244-50(Apr. 1962). (In Japanese)

A variational expression is derived for the neutron blackness β of a fuel rod which has inhomogeneous distribution of nuclear elements depending on the distance from its axis. The following assumptions are made: scattering within the rod is isotropic in the coordinate system and does not change the energy of an entering neutron; the incident neutron current is uniform on the surface of the rod and is isotropic in solid angle; and monochromatic treatment is allowed. The evaluation of the variational expression for β by using the solution of transport equation for neutrons in the fuel rod as a trial function shows that when a lot of Pu^{239} accumulates in the vicinity of the rod surface and U^{235} remains near the axis of the rod, the blackness β in the energy 0.3 ev is increased much more due to the scattering than in the case of the homogenized rod. The values of β for the homogenized rod are compared. Both results agree fairly well as the ratio of absorption to scattering cross section increases. (auth)

19734 AN INVESTIGATION OF THE PRODUCTION OF POLARIZED NEUTRON BEAMS IN THE ENERGY RANGE 18 TO 120 Mev. P. H. Bowen, G. C. Cox, G. B. Huxtable, J. P. Scanlon, and J. J. Thresher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 15: 31-9(Feb. 1962). (In English)

In a search for a polarized neutron beam, neutrons were produced by bombarding thick targets of lithium deuteride and aluminum with protons of 143 Mev. The polarization of the neutrons was investigated as a function of neutron energy between 18 and 120 Mev and at angles of neutron production of 25°, 35°, and 45°. An aluminum target and production angle of 45° have been chosen for future work, the polarization of the resulting neutron beam varying from 0.135 ± 0.029 at 22.5 Mev to 0.308 ± 0.038 at 100 Mev. (auth)

19735 SOME NEW METHODS OF FLUX SYNTHESIS. S. Kaplan (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 13: 22-31(May 1962). (WAPD-T-1374)

A variational principle is applied to develop a method for constructing approximate solutions to the three dimensional, few group diffusion equations using only the solutions of one and two dimensional problems. Three additional related methods are described and a numerical example presented which is representative of several that were studied. It is found that the new methods give considerably improved results compared with the conventional synthesis method. (auth)

19736 THE DIRECT CALCULATION OF DIFFUSION LENGTHS AND DIFFUSION HARDENED SPECTRA. Gerald P. Calame (Rensselaer Polytechnic Inst., Troy, N. Y.). Nuclear Sci. and Eng., 13: 32-9(May 1962).

A numerical procedure for the calculation of thermal diffusion lengths directly from the formalism of Hurwitz and Nelkin is described. The technique is used to compute diffusion lengths for several plastic moderated assemblies, using the mass 1, free proton energy exchange kernel. Agreement of the calculated diffusion lengths with experiment is excellent. (auth)

19737 INELASTIC SCATTERING OF COLD NEUTRONS BY POLYCRYSTALS. P. G. Khubchandani and R. R. Sharma (Atomic Energy Establishment, Trombay, India). Nuclear Sci. and Eng., 13: 40-5(May 1962).

The method given by Sjölander to calculate the one phonon differential inelastic cross section in the case of single crystals was extended to polycrystals. Initially a graphical method is used. It is shown that the method could be converted to a form in which graphical calculations are replaced by an analytic expression. This is similar to the one obtained by Weinstock's approach, except for a factor. Calculations are made for polycrystalline lead for seven different scattering angles. The incident energy corresponds to neutron of temperature 13.6°K or wavelength 8.3 Å. The temperature of lead is taken as 300°K. The mean energy of the scattered neutron is also calculated. Comparison with the method of incoherent approximation shows that the results are widely different from the method of the sum over the allowed reciprocal vectors. (auth)

19738 BOUNDARY, GAP, AND BLACKNESS CONDITIONS IN THE CYLINDRICAL GEOMETRY SPHERICAL HARMONICS APPROXIMATION. W. W. Clendenin (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 13: 46-53(May 1962). (WAPD-T-1412)

Explicit expressions for the Marshak boundary conditions and vacuum gap conditions are developed through the P_5 approximation. A blackness theory is developed for the accurate treatment of regions with high absorption of heavy elements. The relevant coefficients are expressed in terms of solutions of one velocity problem for which boundary conditions are given. (auth)

19739 INVESTIGATION ON A GENERALIZATION OF THE WILKINS THERMALIZATION THEORY VALID FOR HOMOGENEOUS MEDIA TO HETEROGENEOUS AND QUASI-HOMOGENEOUS MEDIA. H. Maerkl (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 4: 39-45(Feb. 1962). (In German)

For the model of a monatomic heavy gas, a relatively simple second-order differential equation for the case of an infinite expanding homogeneous medium was derived by J. E. Wilkins, Jr. from the integral equation describing the thermalization of neutrons by the development of the reciprocal nuclear mass. A study was made to translate the Wilkins considerations to a finite expanding heterogeneous medium. For the mean spatial flux spectrum in the individual medium fractions, an integral equation system was formulated which was then converted by utilization of the heavy gas model into a corresponding system of differential equations. The coupling of the equation system was effected by the collision probabilities P_{ij}. The equation system is discussed for some special cases. Approximations to the mean temperature and scattering nuclear mass were obtained by passage to the limit to (quasi-) homogeneous media. By application of the method to a two-zone cell, the formal theory was reduced to the Wilkins equation for an infinite homogeneous medium under the assumption that the scattering collision on uranium causes no energy modification of the neutrons. Surprisingly simple relations are obtained when the Wilkins spectra of the individual medium fractions are superposed approximately. In this case the differential equations are reduced to simple algebraic expressions for the spectral mean in the individual volume fractions. (tr-auth)

19740 COLLISION PROBABILITIES IN CYLINDRICAL GEOMETRY. Albert Mueller (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 4: 53-6(Feb. 1962). (In German)

For a transport theory multi-group and multi-zone calculation of the neutron flux in a cylindrical reactor cell, one needs the probabilities that a neutron arising in an arbitrary ring zone makes its next collision in another arbitrary ring zone. These probabilities were calculated for source densities which are isotropic and can be developed in a straight power series by r. (tr-auth)

19741 ANHARMONIC EFFECTS IN THE COHERENT SCATTERING OF NEUTRONS BY CRYSTALS. A FORMAL TREATMENT OF SHIFT AND WIDTH OF THE PEAKS IN THE SCATTERING SPECTRUM. J. J. J. Kokkedee (Rijksuniversiteit, Utrecht). Physica, 28: 374-408(Apr. 1962).

Anharmonic effects in crystals are treated by means of many particle perturbation theory, in which the anharmonic part of the Hamiltonian is considered as the perturbation (phonon-phonon interaction). Use was made of diagrams for representing the various matrix elements. Since the one-phonon peaks are considered as separate from the background without confining to lowest order perturbation theory, the treatment is restricted to the case where the line width of a phonon state is small with respect to the energy of the phonon also for strong coupling between the phonons. In this connection the results obtained are expected to be valid only in the temperature range from absolute zero up to temperatures not much higher than the Debye temperature. For these temperatures the influence of two-phonon processes on the line shape may be neglected. An expansion for calculating the line shift and line width in powers of u/d and in terms of simple connected diagrams is obtained (u is the average atomic displacement, d is the smallest interatomic distance in the crystal). Formulas, which express the shift and width in the parameters of the lattice, are given valid to order $(u/d)^2$. (auth)

19742 REVERSAL OF THE SPIN OF POLARIZED THERMAL NEUTRONS WITHOUT DEPOLARIZATION. A. Abrahams, O. Steinsvoll, P. J. M. Bongaarts, and P. W. de Lange (Institutt for Atomenergi, Kjeller, Norway). Rev. Sci. Instr., 33: 524-5(May 1962).

An inexpensive and versatile magnetic guide field for polarized thermal neutrons is described. Methods are discussed to turn the polarization vector of a beam of polarized thermal neutrons in space and with respect to a magnetic guide field in the wave length region of 1.0 to 2.0 Å. Within an experimental error of 2% no depolarization was found. (auth)

19743 ENERGY DISTRIBUTION OF COLD NEUTRONS SCATTERED IN LIQUID METHANE. H. Stiller and S. Hautecler (Kernforschungsanlage, Jülich, Ger. and Centre d'Étude de l'Énergie Nucléaire, Mol, Belg.). Z. Physik, 166: 393-405(1962). (In German)

The interaction between CH_4 molecules was studied by neutron spectroscopic measurements for different phases of the substance. In a first investigation the molecular rotations are found to be completely free in the liquid state. A symmetrical splitting of the level $L = 1$ is observed. A comparison of the experimental results with transition probabilities calculated only from degrees of degeneracy gives good agreement for transitions $\Delta L \geq 2$ and for those

transitions $\Delta L = 1$ which have $L \geq 2$ as the initial state. These transitions, therefore, appear to be rather independent of L. The experiments indicate furthermore, that also with respect to their translational motions the molecules behave like in a gas. (auth)

Nuclear Properties and Reactions

19744 (AFOSR-1565) EVIDENCES FOR OCTUPOLE AND QUADRUPOLE VIBRATIONAL STATES IN Pb^{205}. Technical Note No. 7. I. Bergstroem, E. C. O. Bonacalza, and P. Thieberger (Sweden. Kungliga Tekniska Högskolan, Stockholm and Sweden. Kungliga Vetenskapsakademien. Nobelinstitutet for Fysik, Stockholm). Sept. 1, 1961. Contract AF(052)-118. 29p. (AD-266646)

It is shown by internal conversion coefficient measurements that the 2610 and 2567 kev states in Pb^{205} are $^9/_2+$. It is suggested that the upper state is mainly due to the coupling of the 3− octupole core vibrational state and the $^1/_2-$ neutron hole ground state. Angular correlation measurements were made between the E1 gamma rays going from the 2610 and 2567 kev states to the 703 kev state, and the 703 kev gamma ray de-exciting this state. If the E1 transitions are both assumed to be pure, it follows that the 703 kev gamma ray is due to 98% E2 radiation and 2% M1 radiation. The strong E2 enhancement in the 703 kev ground state transition ($^7/_2-$ yields $^5/_2-$) suggests that the 703 kev state might be due to one phonon quadrupole core vibration coupled to the $^5/_2-$ ground state of the odd neutron. There are also some evidences for the 1615 kev state being originated by a similar coupling between the odd neutron ground state and two phonon quadrupole core vibration. (auth)

19745 (ARF-1193-9) SCINTILLATION SPECTROMETER MEASUREMENTS OF CAPTURE GAMMA RAYS FROM NATURAL ELEMENTS. Quarterly Report No. 3, December 15, 1961 to March 14, 1962. Reginald C. Greenwood and John H. Reed (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 18, 1962. Contract AT(11-1)-578. 53p.

Tests were conducted with the 5 in. × 4 in. NaI(Tl) crystal to determine the range of usefulness of this particular crystal size. From these experiments, it was concluded that there would be some advantage to including low energy capture spectra observed with this crystal for those elements containing prominent lines between approximately 400 kev and 1 Mev. Low energy neutron capture gamma ray spectra were obtained with the 1.5 in. × 1 in. NaI(Tl) crystal for Fe, Co, Rh, Ag, Cd, In, Dy, Ho, Tm, Lu, Yb, Re, and Au and with the 3 in. × 3 in. NaI(Tl) crystal for Fe, Mn, Nd, Sm, Eu, Gd, Tb, Er, and Hg. Many previously unreported lines were observed in these spectra. (auth)

19746 (BAW-1237) U-238 RESONANCE INTEGRAL EXPERIMENT. Interim Report, July 1, 1961 to September 30, 1961. W. G. Pettus and C. Samuel (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Oct. 24, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2578. 21p. (EURAEC-189).

Investigations are being made of U^{238} resonance capture phenomena. Sample holders, counting equipment, and oscillator instrumentation are described. Period and oscillation measurements were made for the determination of the variation of the effective resonance integral with the sample diameter. The procedures used in these measurements are outlined. Preliminary reactivity and modulation coefficients are given for the samples investigated. The methods for interpreting activity and reactivity measurements are discussed. (M.C.G.)

19747 (CERN-62-9) HIGH-ENERGY NUCLEAR REACTION CROSS-SECTIONS. [PART] II. E. Bruninx (European Organization for Nuclear Research, Geneva). Feb. 15, 1962. 129p.

Data on formation cross sections for target elements in the Zn to U region are presented. The cross section values were recalculated on the basis of the monitor reaction, $Ni^{27}(P,3Pm)Na^{24}$, where necessary. These values appear in CERN 61-1. (J.R.D.)

19748 (LA-1697) DETERMINATION OF THE 14-Mev $Li^7(n,n'\alpha)T$ CROSS SECTION FROM SPHERE MULTIPLICATION AND TRANSMISSION MEASUREMENTS. R. G. Thomas (Los Alamos Scientific Lab., N. Mex.). July 1954. Contract W-7405-eng-36. 14p.

By utilizing lithium spherical shell transmission and multiplication measurements, the $Li^7(n,n'\gamma)Li^7$ and the He^6-production cross sections, it was possible to deduce that the 14-Mev $Li^7(n,n'\alpha)T$ cross section is 325 ± 75 mb. A spectrum for neutrons degraded in energy between 0 and 12 Mev is also given. (auth)

19749 (NP-11662) EXCITATION OF VIBRATIONAL AND ELECTRONIC LEVELS IN O_2 BY ELECTRON IMPACT. Technical Report No. 10. Scientific Paper 62-908-113-P3. G. J. Schulz and J. T. Dowell (Westinghouse Electric Corp. Research Labs., Pittsburgh). Mar. 16, 1962. Contract NONR-2584(00). 18p.

Low energy inelastic collisions between electrons and oxygen molecules were studied using the trapped-electron method. Peaks in the trapped-electron current were interpreted as vibrational excitation of the oxygen molecule to the states v = 1 to v = 8. Two of these peaks can be attributed in part to the excitation of the $^1\Delta g$ and $^1\Sigma_g^+$ states. Approximate cross sections at 0.16 ev above threshold are less than 3×10^{-20} and 6×10^{-21} cm^2 for the $^1\Delta g$ and $^1\Sigma_g^+$ states, respectively. For electronic states above 5 ev, the cross sections at 0.16 ev above threshold are of the order of 10^{-18} cm^2. (auth)

19750 (PAN-261/VII) DIFFRACTION SCATTERING OF DEUTERONS ON NONSPHERICAL NUCLEI. J. Borysowicz and J. Dabrowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). July 1961. 16p.

The Drozdov-Blaiv diffraction scattering model was extended to the case of deuteron scattering on nuclei with quadrupole surface deformation. The deuteron diffraction scattering was treated as a superposition of the diffraction scatterings of both the neutron and proton of the deuteron by applying the Achiezev-Sitenko method. The angular distributions obtained were almost identical with those obtained with the Drozdov-Blaiv model except at larger angles where the cross section dropped down faster in the Drozdov-Blaiv model provided the interaction radius was diminished to about its alpha scattering value and the deformation factor was increased. The results are illustrated in the examples of $O^{18}(d,d')O^{18*}$, $Mg^{24}(d,d')Mg^{24*}$, and $Mg^{24}(d,d)Mg^{24}$ reactions. (auth)

19751 (RADC-TN-61-154) SOME EXPERIMENTAL RESULTS ON THE INTENSITY OF LOW ENERGY BREMSSTRAHLUNG FROM THIN AND THICK TARGETS. Paul Fredrickson (Tracerlab, Inc., Waltham, Mass.). June 9, 1961. Contract AF30(602)-2189. 26p. (AD-263288)

Two experiments are described which were performed to measure the Bremsstrahlung output from thin and thick targets. Each experiment was performed to compare the experimental and theoretical results concerning the generation intensity. No calculation or measurements have appeared in the literature dealing with the absolute intensity of emission from very thin targets. On the other

hand, many experiments were performed which verify Kramer's rule for thick targets except for very low bombarding energies (2 to 5 kev). One experiment, reported in the literature, indicated that the intensity was not described by Kramer's rule between 1 and 2 kev. The thin target experiment verified the computational procedures used to determine the flux output. The thick target experiment revealed that no significant departure from Kramer's rule (greater than an order of magnitude) were apparent for electron bombarding energies at 2 to 5 kev. (auth)

19752 (SUI-61-5) GAMMA RAY TRANSITIONS FROM EXCITED STATES OF S^{32} (thesis). Larry Dale Schlenker (Iowa. State Univ., Iowa City. Graduate Coll.). June 1961. Contract [AT(11-1)-72]. 48p.

The $P^{31}(p,\gamma)S^{32}$ reaction was studied at the 355 and 440 kev resonance levels using the State University of Iowa 500 kev Cockcroft-Walton accelerator and thick targets of red amorphous phosphorus. Single crystal analysis techniques were used for the 355 kev resonance identifying strong gamma ray transitions from the 9.19 Mev excitation level to the ground state and a cascade to the 2.24 Mev first excited state. There were also indications of gamma rays having energies of approximately 5.87, 5.44, 4.01, 3.41, and 3.00 Mev but identification of these is not certain. Radiation in the 5 to 6 Mev range is interpreted to be a cascade to the 5.80 Mev level. At 440 kev single crystal and scintillation pair spectrometer analyses identified strong transitions from the 9.27 Mev excitation level to the ground state and branching in two different twofold cascades to the 2.24 Mev first excited state and the 4.47 Mev intermediate excited state respectively. The width of the 440 resonance level was also found to not exceed 10 kev. On the basis of these transitions and the known spins and parities of the ground and first excited states of S^{32} and the ground state of P^{31}, it is predicted that the 440 kev capture state has a spin and parity of 1^+ and that the 355 kev capture state may have a spin and parity of 1^-. (auth)

19753 (TID-15684) THE ELECTRON SPECTRUM OF MERCURY-203 FROM 50 kev TO 300 kev. (thesis). Audley O. Burford (Vanderbilt Univ., Nashville). June 1953. 39p.

The Vanderbilt beta spectrometer was used to make a thorough study of the electron spectrum of Hg^{203} from 50 to 300 kev. Evaporation of the source during collection of data and poor momentum resolution limited the accuracy of the results. An examination of the Auger effect in this isotope was included. A uniform source, mounted on a thin backing of aluminum foil, was made by thermal evaporation of HgCl. Data were collected with a window on the Geiger-Mueller counter thin enough to cause only negligible absorption of electrons in the energy range being studied. The K conversion coefficient was found to be .158 ± .003 and the L + M conversion coefficient found to be .061 ± .001. Measurements of the K Auger yield gave .036 ± .006; the fluorescent yield was .964 ± .006. The ratio of the Auger electron intensities is K-LL : K-LX : K-XY :: 1.00 : .53 ± .11 : .10 ± .10. A specific activity at least double that available for this study would allow the formation of a thinner source of smaller area so that the momentum resolution of the electron lines would be improved. The use of an ammonia-mercury complex was suggested to stop evaporation of the source in the spectrometer. Because these complexes are unstable to heat, some other mercury compound such as HgCl would be evaporated onto the source backing; the backing would then be placed in an atmosphere of ammonia gas to reduce the evaporated compound to an ammonia-mercury complex. (auth)

19754 (TID-15693) A PROPORTIONAL COUNTER SPECTROMETER STUDY OF LOW ENERGY AUGER AND FLUORESCENCE RADIATION (thesis). Roger Clark Crawford (Vanderbilt Univ., Nashville and Oak Ridge National Lab., Tenn.). 1954. 97p.

A double-chamber proportional counter spectrometer constructed for the purpose of detecting and measuring energies and intensities to an accuracy sufficient to allow an approximate measurement of the auger and fluorescence yields of a gas and a solid substance was calibrated. It was then used for study of auger and fluorescence radiation of argon and Cu^{65} produced by K-capture in Zn^{65}. The counter, gas-supply system, and electronic equipment are described. The experimental procedure included gas filling, chamber capacitance measurements, linearity determinations, radioactive source mounting, and spectrum measurements. Proportional counter energetics, fluorescence yield equations, spectrum energy identification, auger electron energy reduction, channel and low energy tailing effects, and fluorescence yields are discussed. Graphs and tables are included. (M.C.G.)

19755 (UCRL-9883(Rev.)) FISSION ENERGY TABLES AND AN APPLICATION TO NUCLEAR CHARGE DIVISION. J. C. Douglas Milton (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 19, 1962. Contract W-7405-eng-48. 383p.

The energy released in fission was calculated, using the mass formula of Cameron, for a large number of possible fragment pairs resulting from the fission of 34 nuclides. The neutron binding energies in the fragments were tabulated. Also included are the maximum possible released energy, as well as the charge and the neutron binding energy corresponding to this maximum. A detailed comparison was made between Cameron's and Seeger's mass equations in their application to fission. In addition, a short discussion of the charge division is given in which the fragments are no longer restricted to spherical shapes. (auth)

19756 (XDC-60-1-157) THE ACTIVITY OF THE FISSION PRODUCTS OF U^{235} (PROGRAM 408). M. R. Smith (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 10, 1959. Contract AT(11-1)-171. 158p.

The fission product decay gamma activity for thermal fission of U^{235} is computed by integrating the data for an instantaneous fission event over a variety of reactor operating histories. The energy release rate as a function of time after shutdown is given for nine different reactor operating histories ranging from one to 10^8 seconds. Spectral data are presented as a cumulative distribution, which is useful in connection with Monte Carlo gamma heating computer programs. GE-ANPD code 408 is described. (W.D.M.)

19757 (AD-265707) ESTIMATION OF THE EFFECTIVE SCATTERING CROSS SECTIONS OF ELECTRONS BY ALKALI ELEMENTS TAKING INTO ACCOUNT THE STRONG COUPLING. R. Damburg and V. Kravchenko. Translated from Latvijas PSR Zinatnu Akad. Vestis, No. 1, 73-6(1960). 8p.

Seaton (Proc. Phys. Soc., 68-A: p.457, 1957) showed that when calculating the excitation of optically allowed transitions with large forces of the oscillators, it is necessary to take into account the strong coupling, because the use of the weak coupling method (for example Born's method) yields for these transitions overestimated values of the excitation cross sections, at times exceeding the theoretical limits. The system of equations is presented for the wave functions

of F_0 and F_1 describing elastic and inelastic scattering in an approximation of two states. (auth)

19758 (CEA-tr-A-1040) LES "FAUX" TRANSURANIENS. HISTOIRE D'UNE ERREUR SCIENTIFIQUE. (The False Transuranics. History of a Scientific Error). O. Hahn (Kaiser-Wilhelm-Institut für Chemie, Tailfingen, Germany). Translated into French by R. Carbonnier. 1961. 26p.

A series of neutron bombardment experiments on uranium carried out by Hahn and his associates from 1934 to 1938 and the false conclusions drawn from these experiments are reviewed. The causes for the erroneous conclusions are discussed and the clarification which the discovery of uranium fission gave is discussed. (J.S.R.)

19759 SOME SIMPLE FEATURES OF THE MOSSBAUER EFFECT. II. SUM RULES AND THE MOMENTS OF THE ENERGY SPECTRUM. Harry J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel). Ann. Phys. (N. Y.), 18: 182-97(May 1962).

General expressions for the moments of the Mössbauer energy spectrum are derived and sum rules for the second moment (dispersion), as well as for the first, are calculated. By examining these results, physical insight into the mechanism of the momentum transfer to the lattice is obtained and the importance of the quantum mechanical zero-point motion which cannot produce a Doppler shift in the classical sense is appreciated. The principal effect of the binding forces is not to hold the atom in the crystal during the emission of the gamma ray; rather it is to produce zero-point motion before the emission. The well known expression for the Mössbauer fraction in a crystal is derived in a simple way using the sum rule for the second moment. (auth)

19760 ANALYSIS OF SPIN-DEPENDENT FISSION ANISOTROPY. R. B. Leachman and E. E. Sanmann (Los Alamos Scientific Lab., N. Mex.). Ann. Phys. (N. Y.), 18: 274-93(May 1962).

Several explanations of the anomalous increase of observed fission anisotropy with increasing target spin are examined. The Bohr theory that the fragment direction is along the K projection of the total angular momentum I is used in the classical limit. The sign and magnitude of the calculated effect of target spin are shown to vary with the form of the distribution in K, but the several different distributions used do not remove the anomaly. The calculated changes of moments of inertia, and thus of the width of the distribution in K, with the nuclear species undergoing fission also appear to be inadequate to explain the target spin effect. The effects of including in the method both nuclear deformation and an angular-momentum-dependent probability of the compound-nucleus transition to fission are calculated with the statistically-expected Gaussian distribution in K. The calculated effect of deformation is much less than the observed target spin effect. With the use of an adequate angular-momentum-dependent transition probability, agreement is reached between the calculated and observed anisotropy change with target spin. The magnitude of this required dependence represents an exponential decrease in the statistical level density with angular momentum that is an order of magnitude greater than expected from rigid moments of inertia. This result is qualitatively in agreement with other analyses of experimental data. (auth)

19761 DETERMINATION OF THE β-DECAY CONSTANT OF K^{40}. D. G. Fleĭshman and V. V. Glazunov. Atomnaya Energ., 12: 320-2(Apr. 1962). (In Russian)

The exact value of the decay constant of K^{40} is of great importance in the determination of the age of geological formations and for studying the natural radioactivity of biological specimens. A scintillating gel, proposed previously by one of the authors (D. G. Fleĭshman and L. G. Shakhidzhanyan, Atomnaya Energiya 6: 669(1959)) was used for measuring the specific activity of K. The absolute activity of the sample was determined by extrapolating the integral spectrum to zero energy level. The c.p. K_2SO_4 used for the measurements was thoroughly mixed with the scintillating gel, and the spectrum of K^{40} was determined by means of a photomultiplier and a 99-channel pulse-height analyzer. The self-absorption of the β particles may be neglected if the dimensions of the crystals are kept below 70 to 80 microns; the error due to γ radiation does not exceed 0.1% of the absolute value of the β activity. The data indicate that the absolute activity per 1 g of natural K is equal to 1630 ± 5 β particles per minute, thus agreeing well with previously reported values. On the basis of the concentration of K^{40} in the natural isotopic mixture, the β-decay constant was found to be $\lambda\beta = 4.67 \pm 0.05 \times 10^{-10}$ $year^{-1}$. (TTT)

19762 SCINTILLATION SPECTROSCOPY MEASUREMENTS OF GAMMA-RAY ENERGIES FROM THE SOURCE OF $Eu^{152,154}$. Takeshi Mukoyama and Sakae Shimizu (Kyoto Univ.). Bull. Inst. Chem. Research, Kyoto Univ., 40: 54-66 (Mar. 1962). (In English)

A series of experiments employing the NaI(Tl) scintillation spectroscopy technique was performed to determine the energies of some strong gamma rays in the decay of $Eu^{152,154}$ mixture. Various combinations of several available calibration sources were used. Care was taken to avoid uncertainties inherent in the measurements and to correct for non-linearities of the system. The average gamma-ray energies measured are (122.7 ± 1.1), (243.8 ± 0.6), (346.2 ± 0.7), (413.2 ± 1.8), (581.8 ± 1.0), (783.1 ± 0.5), (872.6 ± 1.1), (970.2 ± 0.8), (1100.7 ± 0.7), (1282.8 ± 1.5), and (1414.2 ± 0.7) kev. The quoted errors are the standard errors deduced from a series of measurements for each ray. These values are, in general, consistent with published values. (auth)

19763 THE ELASTIC SCATTERING OF Co^{60} γ-RAYS. K. G. Standing and J. V. Jovanovich (Univ. of Manitoba, Winnipeg). Can. J. Phys., 40: 622-53(May 1962).

Cross sections were measured for 90° elastic scattering of Co^{60} γ rays (1.33 and 1.17 Mev) from aluminum, copper, and tin. They agree with theoretical predictions for Rayleigh and nuclear Thomson scattering. A continuum between the Compton and the elastically scattered γ rays interfered with the measurements for heavier elements, since it increased rapidly with Z. The continuum was investigated by observing the γ rays scattered through 60° by thin gold foils. It was found to be produced directly by the γ rays themselves, not by the electrons they knock out of the target atoms. The experimental cross section was compared with that expected for incoherent scattering from the bound atomic electrons. It agrees within a factor of 2 with the cross section given by the form factor approximation, although it is more than an order of magnitude larger than a modification of the form factor, which is based on comparison with elastic scattering calculations. The spectrum of elastically scattered γ rays from lead was examined by a special method in order to reduce the contribution of the inelastic continuum; two photomultipliers faced a single scintillator and pulses from one photomultiplier were counted only when they corresponded to the largest

pulses from the other. The cross section between 12 and 150° was found to be much lower than that of most previous measurements. It agrees with the calculated cross section for Rayleigh and nuclear Thomson scattering within the possible errors in the calculations. Therefore the measurements yield no evidence for the presence of Delbrück scattering, the upper limit on its intensity now being set primarily by the uncertainties in the theory. (auth)

19764 THE EFFECTS OF WEAK MAGNETISM AND THE INDUCED PSEUDOSCALAR INTERACTION ON THE SHAPES OF HIGH-ENERGY BETA SPECTRA. J. M. Pearson (Univ. of Montreal). Can. J. Phys., 40: 656-9(May 1962).

Two tests of the conserved vector current (CVC) theory are proposed on the basis that weak magnetism effects are second forbidden vector contributions to allowed Gamow-Teller transitions and their magnitude depends on whether or not the CVC theory is correct. Comparisons are made of the $\beta-\alpha$ angular correlations in the Li^8 and B^8 decays and of the spectral shapes of the B^{12} and N^{12} decays. Pseudoscalar interactions are also taken into account. (P.C.H.)

19765 MEAN LIVES OF EXCITED STATES IN THE ANALOGUE NUCLEI V^{51} AND Ca^{43}. R. S. Weaver and R. Barton (McGill Univ., Montreal). Can. J. Phys., 40: 660-3(May 1962).

Properties of the first excited states of V^{51} and Ca^{43} are summarized, and measurements of the mean lives of the two states and of the 933 kev state of Ca^{43} are reported. The mean life of the first excited state of V^{51} was measured by delayed coincidence between β particles belonging to the 2130 kev β spectrum and 323 kev γ rays, yielding $\tau = (2.5 \pm 0.6) \times 10^{-10}$ sec. The mean life of the first excited state of Ca^{43} was measured by delayed coincidence between the 619 and 374 kev γ rays following the decay of K^{43} and was determined to be less than 8.0×10^{-11} sec. The mean life of the 993 kev state of Ca^{43} between β particles belonging to the 830 kev β spectrum and 619 kev γ rays was determined to be 1.3×10^{-10} sec. (P.C.H.)

19766 CALCULATION OF CROSS SECTIONS OF (n,γ) REACTIONS. Michel Timores. Compt. rend., 254: 1258-60(Feb. 12, 1962). (In French)

The formulas proposed for the calculation of the cross sections of (n,γ) reactions are examined and modified in view of their application outside of the stability region for a theoretical study of element synthesis. The results tested in the stability region are satisfactory. (tr-auth)

19767 MEAN LIFE OF THE FIRST EXCITED STATES OF GOLD-192, 193, AND 195 AND MERCURY-195. Jerzy Jastzebski and Pierrette Kilcher (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Compt. rend., 254: 1411-13(Feb. 19, 1962). (In French)

The mean life of the first excited state in Au^{192} (4.2 ± 0.6 nsec) and Au^{195} (3.2 ± 0.5 nsec) was measured, and the limiting value for the first excited state in Hg^{195} was determined to be 0.8 nsec and 0.7 nsec in Au^{192}. (tr-auth)

19768 HYPERFRAGMENTS PRODUCED BY 25-Bev PROTONS IN THE NUCLEI OF IONOGRAPHIC EMULSIONS. Germain Baumann, Henri Braun, and Pierre Cüer. Compt. rend., 254: 1608-10(Feb. 26, 1962). (In French)

In the general study of interactions of a beam of 25-Bev protons, 22 of the hyperfragments found were analyzed. The energy distribution, angular distribution, and the charge distribution of these hyperfragments are presented. (tr-auth)

19769 STUDY OF THE REACTION FOR THE PRODUCTION OF THE BERYLLIUM-8 NUCLEI BY COLLISION OF TWO LITHIUM-6 NUCLEI. Mireille Coste and Luis Marquez (Centre d'Études Nucléaires, Saclay, France and Faculté des Sciences, Bordeaux). Compt. rend., 254: 1769-70(Mar. 5, 1962). (In French)

It is shown that the reaction $Li^6(Li^6,\alpha)Be^8$ yields preferentially Be^8 in its 20-Mev excited state. This result is in agreement with the idea of Temmer according to which this nucleus in its excited state can be represented by the configuration Li^6 + d. (tr-auth)

19770 SCATTERING OF 960 Mev/C π^- MESONS BY NUCLEI. Michel Crozon and Jacques Tocqueville (Collège de France, Paris). Compt. rend., 254: 1963-5(Mar. 12, 1962). (In French)

The angular distribution of high-energy π^- mesons scattered by nuclei was studied. The optical model parameters of the nucleus for spinless incident particles, which the experiences of Cronin, Cool, and Abashian on the total cross section (π^-,nuclei) do not allow to be determined, may be found in this way. The experimental results of a preliminary study of this angular distribution are given. (tr-auth)

19771 EMISSION OF NUCLEI OF LITHIUM-8 AND 9 IN THE INTERACTIONS OF 25-Bev PROTONS WITH THE HEAVY NUCLEI OF IONOGRAPHIC EMULSIONS. Germain Baumann, Henri Braun, and Pierre Cüer. Compt. rend., 254: 1966-8(Mar. 12, 1962). (In French)

With the ionographic method, the energy and angular distributions of 969 "hammer" tracks caused by 25-Bev protons are given and compared with the evaporation theory. A part of the high-energy fragments does not behave as the evaporation theory predicts. (tr-auth)

19772 THE ELECTRON SPECTRUM EMITTED DURING THE DECAY OF MERCURY-193 INTO GOLD-193. Jose Sant'Ana Dionisio (Laboratoire de l'Aimant-Permanent, C.N.R.S., Orsay, France). Compt. rend., 254: 1972-4(Mar. 12, 1962). (In French)

The Auger and internal conversion electron spectrum emitted during the decay $Hg^{193} \rightarrow Au^{193}$ was studied with two semi-circular focusing magnetic spectrographs (with a pre-acceleration) in the energy range from 0 to 116 kev. The experimental values of the conversion ratios of the gamma radiation at 32.18 and 38.23 kev were analyzed. (tr-auth)

19773 (p',γ) ANGULAR CORRELATION MEASUREMENTS ON Fe^{56}. B. Gobbi and R. E. Pixley (Eidgenössisches Technische Hochschule, Zurich). Helv. Phys. Acta, 34: 802-3(1961). (In German)

Iron was irradiated with 4.3-Mev protons, and the (p',γ) angular correlation in the excitation of the 845-kev level of Fe^{56} was measured. The absence of symmetry with respect to the recoil direction of the target nucleus in the measured correlation argues against a direct excitation. The experimental results obtained are compared with the angular correlation curves calculated by Sheldon. (J.S.R.)

19774 ANGULAR CORRELATION WITH STATISTICAL REACTION THEORY. Eric Sheldon (Eidgenössische Technische Hochschule, Zurich). Helv. Phys. Acta, 34: 803-12(1961). (In English)

Angular correlation theory was applied to compound nucleus formation by numerical computations of low-energy inelastic scattering on Fe^{56} at $E_p = 4.22$ Mev and $E_n = 2.00$ Mev. As simplifying hypotheses in the calculations, it is assumed that the decay of the compound nucleus causes population of only the first excited state of the residual nucleus and that the energy spread of the beam of incident particles is sufficiently wide to cause excitation of many

compound nucleus states, whose respective wave functions have random relative phases over which averages are taken. From the calculated correlation functions, a correlation surface is constructed as a contour representation of equivalued W's as a function of the emission angles. In the appendix expressions for the angular correlation of three nuclear radiations are derived, and the linear polarization of a 0.845-Mev pure E2 γ from $Fe^{56}(p,p'\gamma)$ or $(n,n'\gamma)$ for $\phi = 90°$ is determined. (J.S.R.)

19775 INELASTIC SCATTERING OF 14.7-Mev NEUTRONS ON U^{238}. P. Huber, Z. Lewandowski, R. Plattner, C. Poppelbaum, and R. Wagner (Universität, Basel). Helv. Phys. Acta, 34: 815-18(1961). (In German)

In order to determine the nuclear temperature of U^{238} from an analysis of the neutron spectrum, it is necessary to consider the fission neutrons. The total inelastic neutron spectrum is composed of the contribution of the fission neutrons from the fission fragments and of the "evaporation spectrum". The inelastic spectrum was determined, and a nuclear temperature of T = 0.36 ± 0.02 Mev was obtained, a value smaller by a factor of three than the corresponding values found for Pb^{208} and Bi^{209}. (J.S.R.)

19776 ABSOLUTE DETERMINATION OF THE THRESHOLD VALUE OF THE REACTION $F^{19}(p,n)Ne^{19}$ AT 4.2 Mev. A. Rytz, H. Winkler, F. Zamboni, and W. Zych (Universität, Zurich). Helv. Phys. Acta, 34: 819-22(1961). (In German)

The threshold energy of the $F^{19}(p,n)Ne^{19}$ reaction at 4.2 Mev was absolutely determined by deflection of 180° in a homogeneous magnetic field. The experimental conditions are described. A value of $E_s = 4234.7 \pm 1.0$ kev was obtained. The sources of error and their contribution to the total error are tabulated. The suitability of this reaction for the calibration of Van de Graaff generators was also investigated. The results showed that the reaction, especially at high energies, is well suited for this purpose. (J.S.R.)

19777 ELASTIC SCATTERING OF 24-Bev PROTONS ON HYDROGEN NUCLEI. G. B. Cvijanovich (Universität, Bern), P. Egli, V. Gorgé, H. Hofer, W. Koch, M. Nikolić, R. Schneeberger, H. Winzeler, M. Zulauf, G. Czapek, and G. Kellner. Helv. Phys. Acta, 34: 823-6(1961). (In German)

The analysis of 480 elastic scatterings of 24-Bev protons on protons in a hydrogen bubble chamber and in emulsions is reported. The target diagram of the cloud chamber events, observed in the direction of the primary beam, gives no indication of left-right symmetry. The angular distribution of the events was determined, and a cross section of $\sigma_{el} = 7.8 \pm 0.7$ mb for $\xi^L > 2$ mrad was obtained. The differential cross sections are shown graphically. (J.S.R.)

19778 THE (n,p) AND (n,α) REACTIONS OF Ca^{40} WITH 6-Mev NEUTRONS. S. Urech, E. Jeannet, and J. Rossel (Université, Neuchâtel, Switzerland). Helv. Phys. Acta, 34: 954-9(1961). (In French)

The technique of nuclear emulsions loaded with fine grains (diameter $\simeq 5\ \mu$) of target material was used for a study of the $Ca^{40}(n,p)K^{40}$ and $Ca^{40}(n,\alpha)Ar^{37}$ reactions at 6 Mev. The angular and energy distributions were measured and the cross sections found to be $\sigma(n,p) = (520 \pm 50)$ mb and $\sigma(n,\alpha) = (430 \pm 100)$ mb. The results are compared with the predictions of the statistical theory of nuclear reactions. (auth)

19779 ABSOLUTE PRECISION DETERMINATION OF SEVERAL RESONANCE AND THRESHOLD ENERGIES AND THE α PARTICLE ENERGY OF Po^{210}. PART I. A. Rytz, H. H. Staub, and H. Winkler (Universität, Zurich). Helv. Phys. Acta, 34: 960-76(1961). (In English)

Precision measurements of the energy of the T(p,n) and $Li^7(p,n)$ thresholds and the energy of the Po^{210} α particle were made. The 180° spectrometer, greatly improved over that used in earlier measurements, has a 0.04, 0.08, or 0.15 mm wide aperture with an orbit diameter of 1 m. The magnetic field was made homogeneous with the aid of a magnetic recording tape, and it was measured point for point by magnetic nuclear resonance. A nuclear resonance probe effected the field stabilization to better than 5×10^{-6}. The Van de Graaff accelerator was stabilized on the 0.4 mm wide middle slit. The threshold values measured on thick targets were 1019.35 ± 0.2 kev for tritium and 1880.48 ± 0.25 kev for lithium. The Po^{210} α energy was 5304.93 ± 0.60 kev. (tr-auth)

19780 SPALLATION OF ARSENIC WITH 590 Mev PROTONS. G. Rudstam and E. Bruninx (CERN, Geneva). J. Inorg. & Nuclear Chem., 23: 161-5(Dec. 1961). (In English)

Yields of about 50 spallation products formed by the bombardment of arsenic with 590 Mev protons were measured. It was found that the cross section distribution can be described by a four-parameter formula which reproduces the experimental cross sections within a factor of two on the average. (auth)

19781 EXCITATION FUNCTIONS OF (d,α) AND (d,αn) REACTIONS ON TUNGSTEN. A. Demildt (I.K.O., Amsterdam). J. Inorg. & Nuclear Chem., 23: 167-71 (Dec. 1961). (In English)

Irradiation of natural tungsten with deuterons gives rise to three radioactive tantalum species due to the following nuclear reactions: $W^{184}(d,\alpha)Ta^{182}$; $W^{186}(d,\alpha)Ta^{184}$, and $W^{186}(d,\alpha n)Ta^{183}$. Calculations of the reaction energies were performed, and the excitation functions of these three reactions were determined with deuterons of up to 22 Mev. The cross-sections of the three reactions have values between 3 and 0.05 millibarn. (auth)

19782 (n,p) AND (n,α) EXCITATION FUNCTIONS OF SEVERAL NUCLEI FROM 7.0 TO 19.8 Mev. B. P. Bayhurst and R. J. Prestwood (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 23: 173-85(Dec. 1961). (In English)

Total cross sections for the (n,p) reaction on Sc^{45}, As^{75}, Sr^{86}, Y^{89}, Zr^{90}, Ag^{109}, Cd^{111}, and Au^{197}, and the (n,α) on Al^{27}, Sc^{45}, As^{75}, Y^{89}, Zr^{92}, Zr^{94}, Nb^{93}, Cd^{112}, Sn^{118}, and Au^{197} were measured at incident neutron energies from 7.0 to 19.8 Mev. The target elements were exposed to D-T neutrons produced in Zr–T targets and to neutrons produced by deuterons on D_2 and T_2 gas targets. The products were isolated and measured by radiochemical methods. The procedures used for the chemical separations are described. Empirical formulas are given for estimating (n,p) and (n,α) cross-sections at maximum and at 14 Mev. (auth)

19783 THE THERMAL NEUTRON FISSION CROSS-SECTION OF 10.1 HR ^{244}Am. S. E. Vandenbosch and J. Gray, Jr. (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem., 23: 187-9(Dec. 1961). (In English)

The thermal neutron fission cross section of the 10.1 hr isomer of Am^{244} was determined by counting fissions induced by neutrons in the thermal column of the Argonne reactor CP-5. A decrease in fissionability with the characteristic 10.1 hr half life was observed. The fission cross-section of 2300 ± 300 barns was obtained by comparing the fission counting rate of Am^{244} with that of a U^{233} standard. (auth)

19784 ELECTRIC-DIPOLE GIANT-RESONANCE ENERGY. F. C. Barker (Australian National Univ., Can-

berra). Nuclear Phys., 31: 529-34(Apr. 1962). (In English)

Shell model calculations for closed-shell nuclei show that the harmonic mean energy for E1 absorption has the same dependence on mass number as the experimental results if a two-particle interaction that is weak in space-antisymmetric states is assumed. (auth)

19785 GROUND-STATE CORRELATIONS IN O^{16}. F. C. Barker (Australian National Univ., Canberra). Nuclear Phys., 31: 535-43(Apr. 1962). (In English)

Admixtures to the simple shell-model ground-state wave function of a nucleus are produced by the residual interaction between nucleons. By treating the interaction as a perturbation it is shown that certain approximations made in calculations of collective states may lead to large errors. Experiment suggests that, for O^{16}, the admixtures to the ground-state wave function may be appreciable. (auth)

19786 THEORY OF NUCLEAR REACTIONS. III. PHYSICAL QUANTITIES AND CHANNEL RADII. J. Humblet (Université, Liège). Nuclear Phys., 31: 544-9(Apr. 1962).

It is shown that physical quantities such as the collision matrix, energies, and total and partial widths of the resonant states, although they are expressed in terms of arbitrary channel radii, are in fact independent of these parameters and define intrinsic properties of the nuclear system. (auth)

19787 THE DECAY OF ^{196}Au. A. H. Wapstra, J. F. W. Jansen, P. F. A. Goudsmit, and J. Oberski (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Phys., 31: 575-83(Apr. 1962). (In English)

The electron-capture decay energy of Au^{196}, as determined from the percentage L-capture in the branch to a 1447-kev state in Pt^{196}, is 1485^{+15}_{-8} kev. In addition to the 1447-kev state, levels at 877 and possibly 1320 kev are populated in this decay. The half life is found to be 6.15 ± 0.15 days. (auth)

19788 THE NEGATON TRANSITION IN ^{196}Au. E. W. A. Lingeman, K. E. G. Loebner, G. J. Nijgh, and A. H. Wapstra (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Phys., 31: 584-6(Apr. 1962). (In English)

The endpoint energy of the β^- spectrum emitted by 6-day Au^{196} is measured to be 259 ± 4 kev, as observed by measurements in coincidence with the following 426-kev gamma transition. For the half life of Au^{196}, a value 6.07 ± 0.11 days is found. (auth)

19789 INTERNAL CONVERSION OF THE 1119 kev TRANSITION IN ^{65}Cu. Sakae Shimizu and Yasuyuki Nakayama (Kyoto Univ.). Nuclear Phys., 31: 600-10 (Apr. 1962). (In English)

The internal K-conversion coefficient of the 1119-kev transition in Cu^{65} was measured by an intermediate-image-focusing spectrometer using the comparison method applied to the 1173-kev gamma rays from Co^{60}. From the known internal conversion coefficient of this transition, the value of the 1119-kev transition was determined to be $\alpha_K = (1.70 \pm 0.19) \times 10^{-4}$. The multipolarity assignment of the transition was also studied on the basis of the result obtained, taking into account the experimental and theoretical spin and parity assignments. A mixture of 59% M1 + 41% E2 was clearly established, corresponding to a mixing ratio E2/M1 of 0.83. (auth)

19790 SEMI-CLASSICAL SCATTERING FROM A COMPLEX NUCLEAR POTENTIAL. M. Rosen (Univ. of Minnesota, Minneapolis). Nuclear Phys., 31: 664-77(Apr. 1962). (In English)

A three-dimensional semi-classical treatment of scattering from a complex nuclear potential is given, and its relation to the classical formulation is shown. A three-dimensional effect that takes into account the derivatives of the potential transverse to the classical trajectories is explicitly indicated and evaluated for the uniform case. This correction, proportional to the ratio of the curl of the flux to the flux itself, tends to decrease the discrepancy found between the classical and quantal values of the divergence of the flux. For those regions of the nucleus where the discrepancy and the corrections are large, however, the validity of the semi-classical and classical approximations breaks down, and consequently a discrepancy is not unexpected. (auth)

19791 A SIMPLE DIRECT REACTION MODEL OF PROTON INELASTIC SCATTERING. A. J. Kromminga and I. E. McCarthy (Univ. of Adelaide). Nuclear Phys., 31: 678-88(Apr. 1962). (In English)

The model for angular distributions in direct nuclear reactions is extended to the case of proton inelastic scattering, a reaction whose angular distributions at medium energies are unintelligible from the point of view of the plane-wave Born approximation. The model is closely analogous to the plane-wave model in that it does not require a partial-wave expansion of the optical model wave functions. The distortion is included by simple but realistic generalizations of the optical-model wave functions. A parameter representing the focus in the wave functions is derived, which is seen to account for the shapes of the angular distributions for the (p,p′) reaction on carbon-12 at medium energies. (auth)

19792 NEUTRON ANGULAR DISTRIBUTIONS FROM THE $Be^9(\alpha,n)C^{12}$ REACTION AT 14.1, 13.9 AND 13.5 Mev. A. Nilsson and J. Kjellman (Nobel Inst. of Physics, Stockholm and Research Inst. of National Defence, Stockholm). Nuclear Phys., 32: 177-89(May 1962). (In English)

The angular distributions of the neutrons to the ground state and to the first, second, third, and fourth excited states of C^{12} from the $Be^9(\alpha,n)C^{12}$ reaction were measured with the time-of-flight technique at three α energies, 14.1 ± 0.1, 13.9 ± 0.1, and 13.5 ± 0.1 Mev. The ground state and the first and second excited state groups could be resolved at all angles, while the third and the fourth excited state groups had to be separated by use of the known shape of the broad 10.1-Mev group. The reason for making measurements at these energies was that the excitation energy in C^{13} for an α energy of 14.1 Mev corresponds closely to a C^{13} level at 20.5 Mev, which might increase the probability for compound nucleus formation relative to a direct reaction at this α energy. (auth)

19793 COULOMB EXCITATION OF Pd^{108}, Pd^{110}, Ru^{102}, AND Ru^{104} USING OXYGEN IONS. D. Eccleshall, B. M. Hinds, and M. J. L. Yates (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys., 32: 190-223(May 1962). (In English)

Oxygen-16 ions having energies up to 40 Mev were used to excite levels in Pd^{108}, Pd^{110}, Ru^{102} and Ru^{104} by the direct and double-E2 Coulomb-excitation mechanisms. The decay of these levels was observed by detecting γ rays emitted from thick targets either directly or in coincidence with backscattered oxygen ions. Collective 2+ and 4+ levels at about twice the excitation energy of the first excited state were observed in the four nuclei, and in Pd^{108} the 0+ state at the same excitation energy as the 4+ state was probably also excited. Values of the ratio $B_{E2}(2+ \rightarrow 4+)/B_{E2}(0+ \rightarrow 2+)$ were obtained for the four nuclei and were consistent with the predictions of the phonon model. (auth)

19794 SEARCH FOR THE (n,β^-) REACTION. T. J. Kennett and K. Fritze (McMaster Univ., Hamilton, Ont.). Nuclear Phys., 32: 224-35(May 1962). (In English)

An attempt was made to determine the cross section $\sigma(n,\beta^-)$ for the reaction $Hg^{199}(n,\beta^-)Tl^{200}$. A value of $\sigma(n,\beta^-) \leq 2 \times 10^{-35}$ cm^2 was obtained. The cross section contained a limit because of the interference from secondary reactions. The result was not inconsistent with that derived from elementary considerations. (auth)

19795 MEASUREMENT OF THE EFFECTIVE CROSS SECTIONS (γ,n) OF Cu, Ce, La, Ta, Au, Pb, AND Bi IN ABSOLUTE VALUES. J. Miller, C. Schuhl, and C. Tzara (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys., 32: 236-45(May 1962). (In French)

Monochromatic photons obtained by annihilation in flight of positrons are used to obtain absolute photoneutron cross sections of copper, lanthanum, cerium, tantalum, gold, lead, and bismuth in the "giant resonance" peak. The integrated cross sections are obtained. (auth)

19796 ANGULAR DISTRIBUTION OF INTERNAL BREMSSTRAHLUNG IN THE CAPTURE OF ORBITAL ELECTRONS. Yujiro Koh (Osaka City Univ.), Osamu Miyatake, and Yoiti Watanabe. Nuclear Phys., 32: 246-66(May 1962). (In English)

The angular correlation between the internal bremsstrahlung (I.B.), the nuclear spin, and the successive nuclear γ rays is given in a general form for allowed and first forbidden transitions. The Coulomb effect on the electron in the virtual state is not taken into account. Explicit forms of the main parameter contained in the correlation function are given in tables. Owing to the parity-violating terms, some amount of asymmetry appears in the correlation functions. Numerical calculations are carried out for the transitions $Co^{58}(2+) \rightarrow Fe^{58}(2+)$ and $Rb^{84}(2-) \rightarrow Kr^{84}(2+)$ under specified assumptions. The anisotropy of the angular distribution of I.B. is independent of the I.B. energy in the case of allowed-type K-captures. Nuclei suitable to test the theory are tabulated. Simultaneous observations of I.B. and positrons on a single source give information concerning the coupling consuants. (auth)

19797 A LEVEL DENSITY ANALYSIS OF EXCITED STATES FORMED BY RADIATIVE PROTON CAPTURES. J. Dubois (Chalmers Tekniska Hogskola, Goteborg). Nuclear Phys., 32: 267-72(May 1962). (In English)

Some (p,γ) excitation curves of nuclei in the mass region A = 44 to 50 are fitted to the Lang and Le Couteur level-density formula. The parameter a is determined. The data are also fitted to the constant-temperature level-density formula. (auth)

19798 NUCLEAR RESONANCE EFFECTS IN COULOMB EXCITATION. T. A. Griffy and L. C. Biedenharn (Duke Univ., Durham, N. C.). Nuclear Phys., 32: 273-85(May 1962). (In English)

The changes in the Coulomb excitation process as a result of nuclear interactions in the incident and exit channels are calculated. It is shown that resonances in the elastic scattering channel interfere coherently with the Coulomb excitation process and thus lead to anomalies in the cross section for Coulomb excitation. The predictions are compared with results for the reaction Na^{23} $(p,p'\gamma)$. (auth)

19799 ASYMMETRIC ROTATOR MODEL OF ODD-MASS NUCLEI. Karl T. Hecht (Univ. of Michigan, Ann Arbor) and G. R. Satchler. Nuclear Phys., 32: 286-318 (May 1962). (In English)

The asymmetric-rotator model is extended to odd-mass nuclei by coupling a single nucleon to an inert core of well-stabilized asymmetric equilibrium shape. Rotational energies are calculated for states with spin I by means of numerical diagonalization of $(I + \frac{1}{2}) \times (I + \frac{1}{2})$ rotational matrices, which depend in a complicated way on the state of the odd nucleon. The state of the odd nucleon is described by single-particle wave functions, such as those calculated as generalizations for the asymmetric case of the wave functions for axially symmetric nuclei. The rotational energy spectrum for a given particle excitation is in general very rich in number of levels and may consist of a complicated sequence of spin values. In many cases, however, particularly for small asymmetries, the rotational spectra may consist of several well-separated or overlapping sequences of spin states which resemble the rotational bands of axially symmetric nuclei, especially insofar as K (which given the projection of I on the body-fixed z-axis) may be approximately a good quantum number for each sequence. In a survey of odd-mass nuclei around A = 190, no clear-cut evidence is found for the existence of nuclei with a well defined asymmetric equilibrium shape. Calculations for Ir^{191} and Re^{185} indicate only that it may be very difficult to distinguish between symmetric- and asymmetric-rotator models when the asymmetry is small. Calculations for Pt^{195} show that, although the observed level scheme can be reproduced by asymmetric-rotator theory, the observed electromagnetic transition probabilities are not in agreement with the predictions of the simple asymmetric-rotator model. (auth)

19800 EXPERIMENTAL STUDY OF THE NUCLEAR LEVELS OF SAMARIUM 151. Roland Chery (Institut de Physique Nucléaire, Faculté des Sciences, Lyon). Nuclear Phys., 32: 319-45(May 1962). (In French)

The study of γ radiation emitted by disintegration of Pm^{151}, carried out with scintillation counters, permits completion of the nuclear level scheme of Sm^{151}. An analysis is made of the direct β ray observed in coincidence with γ rays having energies of 1300, 1135, 960, 260, and 485 kev (±2%). The study of direct γ rays and of $\gamma\gamma$ coincidence makes possible the detection of 3 gamma rays of energy 65 kev, 2 gamma rays of energy 100 kev, 2 gamma rays of energy 170 kev (165 kev + 175 kev), and single gamma rays of energies 240, 275, 340, 440, 650, and 715 kev. The estimate of $\log_{10}$ ft permits a classification of the β spectra as first-forbidden ($\Delta J = 0, 1$, yes). The average lifetimes of the 65 and 100 kev levels are $\leq 5 \times 10^{-10}$ and $\leq 10^{-9}$ sec respectively. The measurement of angular correlations of the transitions 175 kev-165 kev, 240 kev-100 kev, 257 kev-65 kev, makes possible a determination of the spin of the first excited levels of Sm^{151}. The gamma ray of ≈1500 kev does not belong to Samarium 151 and it is possible to predict a transition of 35 kev between the 65 and 100 kev levels, although it is not observed with the technique used. (auth)

19801 STUDY OF LOW-ENERGY ELECTRONS EMITTED SIMULTANEOUSLY WITH β-RAYS. M. Spighel and F. Suzor (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France). Nuclear Phys., 32: 346-9(May 1962). (In French)

Spectra of low-energy electrons accompanying the β decay of Na^{22}, P^{32}, and Pm^{147} are measured and show disagreement with the theory of self-ionization. (auth)

19802 THE NEUTRON ELASTIC SCATTERING CROSS SECTION OF U^{233} BELOW 20 ev. M. S. Moore and F. B. Simpson (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Sci. and Eng., 13: 18-21(May 1962).

The neutron scattering cross section of U^{233} was meas-

ured relative to that of copper below 20 ev on the Materials Testing Reactor fast chopper. The observed scattering cross section is adequately described by previously obtained multilevel parameters, which give a value for the potential scattering of 12.6 b. The data are not of high enough quality to permit the assigning of spins to the resonances. (auth)

19803 IMPURITIES IN NUCLEAR GRAPHITE AND THEIR EFFECTS ON THE ABSORPTION CROSS SECTION FOR THERMAL NEUTRONS. E. Fitzer, W. Gebauhr, and E. Nedopil (Siemens-Planiawerke A. G., für Kohlefabrikate, Meitingen, Ger. and Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 4: 1-9(Feb. 1962). (In German)

Impurities occurring collectively in nuclear graphite were accurately determined with spectral and activation analytical methods. The individual concentrations of rare earths were measured for the reactor graphite available in the German Federal Republic. The increase of the absorption cross section for thermal neutrons caused by these impurities, including the gas impurities, was calculated for the purest graphite as 0.38 mb. This total analysis permitted the indirect determination of the absorption cross section of pure carbon as the physically measured absorption cross section of the graphite block could be adjusted for the impurity-caused cross section increase. From the measurements available, the value $\sigma_a = 3.58 \pm 0.08$ mb was obtained for pure carbon. (tr-auth)

19804 MEASUREMENT OF THE M/L CAPTURE RATIO IN Ge^{71} DECAY. C. Manduchi and G. Zannoni (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 24: 181-3(Apr. 1, 1962). (In English)

Measurements are made of the M/L and K/L capture ratios of Ge^{71}, which decays solely by allowed electron capture. The M/L and K/L ratios are 0.141 ± 0.010 and 8.42 ± 0.005, respectively. The measured M/L values is compared with several theoretical calculations. (T.F.H.)

19805 THE WIDTH OF ISOBARIC STATES OBSERVED IN (p,n) REACTIONS. A. M. Lane and J. M. Soper (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 1: 33(Apr. 15, 1962).

The isobaric-state widths are calculated using the shell-model states substituted for φ_i in the relation $\Gamma_c = 2\pi\rho_i \langle\varphi_i|v_c|\varphi\rangle^2$, where the bar indicates the average states φ_i of the final nucleus near the energy of the isobar state φ, and ρ_i is their density. v_c is the charge of Coulomb interaction in passing from the target to the final nucleus. Arguments used in the theory of the nuclear absorption potential W_n enable the substitution. States λ fall into three classes: those of the same nucleon configuration as φ, those in which only the converted proton is excited, and those in which a target proton is excited. (L.N.N.)

19806 THE 0^+ STATES IN OXYGEN. N. Vinh-Mau (Università, Rome) and G. E. Brown. Phys. Letters, 1: 36-8(Apr. 15, 1962).

Calculations involving all one and two-particle energies at $2\hbar\omega$ (unperturbed), where $\hbar\omega$ is the shell spacing, were performed. Rough approximations were employed; zero-range forces were used; and spin-orbit and spin-dependent forces were neglected. The lowest 0^+ state is given in a coherent mixture of two-particle and two-hole excitations; there is no breakdown of the independent-particle ground state in the model. (L.N.N.)

19807 POLARISATION OF NUCLEI OF Au^{198} IN IRON. N. J. Stone and B. G. Turrell (Clarendon Lab., Oxford). Phys. Letters, 1: 39-41(Apr. 15, 1962).

Iron containing 0.2 at. % Au^{197} was irradiated, producing Au^{198}. The samples were annealed at 1000°C for 12 hr, and Co^{60} was diffused into them; the plates were then soldered to the ends of copper fins embedded in a chrome potassium alum pill containing salt demagnetized from 25 kilo oersteds at 1 to 0.012°K. The specimen was magnetized in a field of 1.5 oersteds with the field direction determining the polarization axis. Normalization counts were made by switching off the polarizing field. (L.N.N.)

19808 ANGULAR DISTRIBUTION OF CARBON NUCLEI FROM α-INDUCED FISSION OF NEON-20. N. O. Lassen (Universitet, Copenhagen). Phys. Letters, 1: 65-6(Apr. 15, 1962).

The C^{12} angular distributions from the α fission of Ne^{20} (i.e., $Ne^{20} + He^4 \rightarrow C^{12} + C^{12}$) are measured in the center-of-mass system from 0 to 180°. The maxima and minima in the angular distribution are analyzed by means of Legendre polynomials. (T.F.H.)

19809 THE THICKNESS OF THE NUCLEAR SURFACE. Erich Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Letters, 1: 84-7(May 1, 1962).

The effect of the nuclear surface thickness (a) on the scattering of bombarding particles is investigated. The principal effect at low energies is found to be an increase in the nuclear penetrability by a factor that depends on a. The value of this factor lies between 2 and 3 for realistic values of a. The value of a is calculated to be 0.31 ± 0.06, for low-energy s-wave neutron scattering and absorption by complex nuclear potentials of the square-well and Saxon-Woods types. (T.F.H.)

19810 A REMARK ON QUASI-FREE SCATTERING. Tore Berggren (NORDITA, Copenhagen), G. E. Brown, and Gerhard Jacob. Phys. Letters, 1: 88-90(May 1, 1962).

For (p,2p) and (e,e'p) reactions on light and medium nuclei, at incident energies of 100 to 400 Mev for protons and 300 to 1000 Mev for electrons and at zero momentum transfer to the target nucleus, integral expressions are found for the transition amplitude, the scattering amplitude, and the overlap integral. These integral expressions are obtained by considering the incoming and outgoing particles as plane waves. Conditions under which maxima and minima occur in the angular correlations of the final-state particles are determined. Results on Li^6(p,2p) are reviewed. (T.F.H.)

19811 THE HALF-LIVES OF THE FIRST EXCITED STATES OF ^{203}Tl AND ^{192}Pt. Th. J. De Boer, H. Voorthuis, and J. Blok (Vrije Universiteit, Amsterdam). Physica, 28: 417-22(Apr. 1962).

A delayed coincidence apparatus was built to measure lifetimes of excited states of even-even nuclei. To test the apparatus on possible systematic errors, the mean life of the 279 kev excited state of Tl^{203} was measured with the result $\tau\gamma = (4.90 \pm 0.04) \times 10^{-10}$ s, which is in good agreement with other results. The half-life of the first excited state of Pt^{192} was measured as $T_{1/2} = (2.72 \pm 0.36) \times 10^{-11}$ s. This value is compared with the half-lives of the first excited states of even-even nuclei with $44 \leq Z \leq 80$. (auth)

19812 ON THE GAMMA-RAY TRANSITIONS FOLLOWING THE ELECTRON CAPTURE DECAY OF Tb^{155}. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A, 55: 174-7(Mar. 1962). (In English)

Gamma spectrum of Tb^{155} was obtained from the observed composite spectrum of $Tb^{155+156}$ and the intensities of gamma rays of Tb^{155} were determined. The level scheme

which supports the results of internal conversion electron studies with Tb^{155} and Eu^{155} is presented. (auth)

19813 ELECTRON NUCLEAR DOUBLE RESONANCE OF THE DIVALENT EUROPIUM ION. J. M. Baker and F. I. B. Williams (Oxford Univ.). Proc. Roy. Soc. (London), A267: 283-94(May 8, 1962).

The electron nuclear double resonance spectrum of Eu^{151} and Eu^{153} is measured in a single crystal of calcium fluoride containing about 0.01% Eu^{2+}. The spectral lines are narrow (~10 kc), so the hyperfine structure parameter and the nuclear g-value can be measured to high precision. In order to fit the measured line positions to the spin Hamiltonian that is usually assumed for the system it is necessary to add small higher-order terms. (auth)

19814 DETERMINATION OF THE MULTIPOLARITY OF TRANSITION WITH THE ENERGY OF 19.3 kev IN Yb^{171}. B. S. Dzhelepov and I. M. Rogachev. Vestnik Leningrad. Univ., No. 4, Ser. Fiz. i Khim., No. 1, 56-8(1961). (In Russian)

The internal conversion spectrum of Lu^{171} was investigated. The L_I, L_{II}, and L_{III} conversion lines corresponding to the 19.3 kev transition in Yb^{171} were observed. Analysis of the relative intensities of the L-conversion lines leads to the conclusion that the 19.3 kev transition is either E1 or a mixture of (58–69) % E2 + (42 – 31) % M1. (auth)

19815 THE INFLUENCE OF THE FINITE SIZE OF THE NUCLEUS ON THE POLARIZATION OF PARTICLES IN THE BREMSSTRAHLUNG. F. S. Sadykhov. Vestnik Moskov Univ., Ser. III, No. 6, 12-19(1961). (In Russian)

The influence of nuclear finite size on particle polarization is investigated. An expression is derived for the effective bremsstrahlung cross section considering the finite size of the nucleus and particle spin correlations. The influence of the mean square radius of the nucleus on electron depolarization is determined. (tr-auth)

19816 I. ABOUT LOWER EXCITED STATES OF Ca^{40}. II. THE COLLECTIVE EXCITED STATES OF Mn^{55}. S. S. Vasil'ev, E. A. Romanovskii, and G. F. Timushev. Vestnik Moskov. Univ., Ser. III, No. 6, 88-90(1961). (In Russian)

I. Properties of excited states of Ca^{40} are studied as a contribution to the theory of spherical nuclei and nuclei with A < 40 mass number. The inelastic scattering of 6.6-Mev protons on Ca^{40} was measured and differential cross sections (in mb/steradian) are tabulated. The order of error is ~10 to 15%. The obtained data indicate 0^+, 3^-, and 2^+ for Ca^{40} spins and parities at lower level. The similarity of the sequence to the lower levels in O^{16} is of great importance in developing the theory of spherical nuclei. II. The inelastic scattering of 6.6-Mev protons by Mn^{55} was measured and differential cross sections, with an error of ~10 to 15%, are tabulated. The angular distribution of protons at 0.131, 0.984, 1.291, and 1.885 Mev differ sharply from the angular distribution at 1.523 Mev and the angular distribution of neutrons in the reaction $Mn^{55}(p,n)Fe^{55}$. The experimental data for the investigated levels do not agree with predictions of the statistical theory. An analysis of the obtained experimental data, data on the $(n,n\gamma)$ cross section of Mn^{55}, and the ratios of intensities of γ transitions from Mn^{55} levels to the ground ($I = 5/2^-$) and the first excited level indicated $I = 3/2^-$, $I = 11/2^-$, $I = 3/2^-$ (single level) and $I = 7/2^-$ (most probable) for the 0.984, 1.291, 1.523, and 1.885 Mev levels, respectively. The obtained results show the existence of collective and single excitation states in Mn^{55}. (R.V.J.)

19817 INELASTIC POSITRON SCATTERING ON ATOMIC NUCLEI. Rudolf Rodenberg (Universität, Tübingen, Ger.). Z. Physik, 166: 439-46(1962). (In German)

The ratio of the total and differential cross section for the inelastic positron-nucleus scattering $(\bar{e}, \mathcal{N})$ process to the total $(\gamma, \mathcal{N})$ cross section is derived in Born approximation for electric and magnetic dipole transitions. The result agrees with that obtained for the $(e, \mathcal{N})$ processes. Using the relativistic Coulomb eigenfunctions for the continuous spectrum of the positrons, the Coulomb correction, the effect of screening, and the effect of finite nuclear size agree with the $(e, \mathcal{N})$ process, when the annihilation of positrons with atomic electrons is neglected, and for positron energies $E^+_{1,2} > 10$ Mev. The effect of finite nuclear size is only calculated in Born approximation. For $E^+_{1,2} \leq 2$ Mev only the Coulomb correction differs from that obtained for the $(e, \mathcal{N})$ process. In the angular distribution for the $(\bar{e}, \mathcal{N})$ process there should be no interference of positron waves scattered by different multipoles, where the inelastic scattered positrons are detected. Numerical calculations were carried out for nuclei with Z = 6, 29, and 82 and scattering angles $\vartheta = 1°$, 132°, 160°, and 180° of the positron. This theory can be compared with the experiments in progress by W. C. Barber et al. using positrons for the inelastic scattering process at nuclei. The two- and three-virtual quanta-exchange effect in the $(\bar{e}, \mathcal{N})$ cross section is below 1.3% for positron energies between $10 \leq E^+_1 \leq 300$ Mev, and decreases rapidly for higher energies. This theory is also valid for inelastic scattering processes with positive μ mesons on nuclei; one has only to change the mass in the resultant equations. (auth)

19818 THE CROSS SECTIONS OF SOME (n,nα) REACTIONS FOR NEUTRON ENERGIES BETWEEN 12 AND 19 Mev. M. Bormann, S. Cierjacks, R. Langkau, and H. Neuert (Institut für Experimentalphysik, Hamburg). Z. Physik, 166: 477-93(1962). (In German)

Cross sections of (n,nα) reactions on V^{51}, Cu^{65}, Ga^{71}, Br^{81}, K^{39}, I^{127}, and Cs^{133} were investigated in the energy range from 12 to 19.6 Mev by measuring the radioactivities produced. Neutrons of these energies were produced by bombarding a thin tritium target with 3-Mev deuterons. In all cases considered the cross section increases rapidly with the neutron energy. In addition some (n,2n) reactions on I^{127}, Br^{81}, and Cu^{63} and (n,p) reactions on Fe^{56} and Ga^{69} were studied in the same way; the results were compared with cross sections which were calculated according to the statistical theory. (auth)

19819 HALF LIFE, ELECTRON CAPTURE RATIO, AND β SPECTRUM OF Tl^{204}. Heinrich Leutz and Klaus Ziegler (Universität, Heidelberg). Z. Physik, 166: 582-9 (1962). (In German)

Half life, P_L/P_K capture ratio, and β spectrum of Tl^{204} were studied with a scintillation spectrometer. To avoid source absorption and scattering troubles, the Tl^{204} source was built into the lattice of NaI(Tl) crystals. The half life measurements were performed over a period of 2.2 years, and a half life of 3.81 ± 0.04 years was obtained. The P_L/P_K capture ratio was determined at 0.41 ± 0.03. This ratio gives a disintegration energy of 442^{+32}_{-24} kev for the unique first forbidden electron capture decay of Tl^{204}. For the branching ratio of electron capture to β^- decay a value of (2.15 ± 0.06)% and for the ratio of K capture to β^- decay a value of (1.53 ± 0.05)% were found. The β^- spectrum of Tl^{204} was measured from 200 down to 6 kev and yields an experimental shape factor which deviates below an energy of ~90 kev from the theoretical shape factor $q^2L_0 + 9L_1$. Reasons for this deviation which is opposite to the one obtained with magnetic spectrometers are discussed. (auth)

19820 YIELD RATIO OF SOME ACTIVITIES PRODUCED BY PHOTONUCLEAR REACTIONS IN CERIUM AND SILVER. H. Fuchs, R. Kosiek, and U. Meyer-

Berkhout (Universität, Heidelberg). Z. Physik, 166: 590-3(1962). (In German)

Samples of metallic silver and cerium oxide were irradiated with 31-Mev and 34-Mev bremsstrahlung. Relative yields of the induced activities were obtained by counting the emitted gamma quanta or by β counting. The yield ratio $Y[Ag^{107}(\gamma,n)Ag^{106}m]/Y[Ag^{107}(\gamma,n)Ag^{106}g]$ for 34-Mev bremsstrahlung was found to be (0.08 ± 0.02). The corresponding ratio $Y[Ce^{140}(\gamma,n)Ce^{139}m]/Y[Ce^{140}(\gamma,n)Ce^{139}g]$ at 31 Mev was (0.19 ± 0.01). (auth)

19821 ENERGY DEPENDENCE OF BETA-GAMMA DIRECTIONAL CORRELATION IN THE DECAY OF Lu^{177}. M. S. El-Nesr and E. Bashandy (Uppsala Univ.). Z. Physik, 167: 100-10(1962). (In English)

The directional correlations for the 174 kev beta and the 208 kev gamma cascade and for the 384 kev beta and the 113 kev gamma cascade in the decay of Lu^{177} were measured as a function of the energy of the beta particles. A magnetic lens spectrometer was used to select the energy of the beta rays. For the first cascade the observed correlation is isotropic. For the 384 kev beta and the 113 kev gamma cascade, the anisotropy factor $A_2(W)$ in the beta-gamma directional correlation $W_{\beta\gamma}(\vartheta,W) = 1 + A_2(W) P_2(\cos\vartheta)$ is proportional to P^2/W and its value is $A_2(1.48) = +0.0575 \pm 0.0068$. The analysis of the data shows that the ξ approximation for first-forbidden nonunique beta transitions represents the results of the 384 kev beta and the 113 kev gamma cascade in a very satisfactory manner. (auth)

19822 A SEARCH FOR NUCLEAR STRUCTURE EFFECTS IN Tm^{169}. Z. Grabowski, J. E. Thun, M. S. El-Nesr, and W. D. Hamilton (Uppsala Univ.). Z. Physik, 167: 111-22(1962). (In English)

The study of nuclear structure effects in internal conversion was extended to the Tm^{169} nucleus. Gamma-gamma, electron-gamma, and gamma-electron directional correlations of the 177 kev–131 kev and the 198 kev–110 kev cascades were measured. The following results were obtained: $A_2(177\gamma - 131\gamma) = +0.275 \pm 0.007$, $A_4(177\gamma - 131\gamma) = -0.005 \pm 0.016$, $A_2(177K - 131\gamma) = +0.002 \pm 0.007$, $A_2(177\gamma - 131K) = +0.497 \pm 0.010$, $A_2(198\gamma - 110\gamma) = +0.295 \pm 0.007$, $A_4(198\gamma - 110\gamma) = -0.013 \pm 0.017$, $A_2(198K - 110\gamma) = +0.001 \pm 0.008$, $A_2(198\gamma - 110K) = -0.005 \pm 0.006$. The results of the electron-gamma directional correlation measurements for the strongly retarded K-forbidden 177 kev M_1 transition are in agreement with the theory for small λ values. It is thus concluded that nuclear structure effects are not appreciable. For the retarded K forbidden 198 kev M_1 transition the experimental results are also in agreement with theory for small λ values but do not exclude high λ values. (auth)

Particle Accelerators

Refer also to abstract 19092.

19823 (TID-15647) A HIGH INTENSITY NANOSECOND PULSED VAN DE GRAAFF ACCELERATOR. Leon E. Beghian and Matti K. Salomaa (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [May 14, 1962]. 34p. Contract [AT(30-1)-2098].

A description is given of a Van de Graaff generator modified for nanosecond pulsing in the terminal. The beam is chopped by sweeping past a limiting aperture by an RF oscillator. A discussion is given for the choice of design parameters. Pulse widths as low as 2×10^{-9} seconds were obtained. Typical operating conditions are 3×10^{-9} seconds pulse width, $1/40$ duty cycle, peak currents 0.8 to 1 ma, with an average current of 17 μa. Measured gamma ray and neutron time spectra are shown. (auth)

19824 (FTD-TT-61-342) URANIUM GRAPHITE POWER REACTOR WITH DIRECT FEEDING OF STEAM TO TURBINES. N. A. Dollezhal (Dolleshal), P. I. Aleshchenkov, I. Ya. Emel'yanov, et al. Translated from p.41-52 of "Power Reactor Experiments. Proceedings of a Symposium, Vienna, 23-27 October 1961. Vol. II" (a publication of the International Atomic Energy Agency, Vienna, 1962. (STI/PUB/51(Vol.II)(p.41-52)). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11270.

19825 (FTD-TT-62-147) TUBULAR ELECTRON BEAM OF CONICAL FORM IN A "CONICAL" MAGNETIC FIELD. T. F. Loginova. Translated from Radiotekh. i Elektron., 6: 1540-4(1961). 9p.

Aspects of focusing a tubular electron beam converging or diverging along the cone with definite angle of inclination relative to the axis are examined. Experiments were conducted to show that with the aid of conical magnetic fields it is possible to focus a hollow electron beam of low thickness over intervals greater than 100 mm. (J.R.D.)

19826 A 105cm FIXED FREQUENCY CYCLOTRON OF KYOTO UNIVERSITY. Kiichi Kimura, Yoshiaki Uemura, Masateru Sonoda, et al. (Kimura Lab., Japan). Bull. Inst. Chem. Research, Kyoto Univ., 39: 368-406(Dec. 1961). (In English)

A 105-cm fixed frequency cyclotron at Kyoto University is described. The azimuthal asymmetry of the magnetic field of the cyclotron was reduced up to 0.01%, and the median plane of the dees and that of the magnetic field coincide each other within 1 mm. In order to drive the self-excited oscillator above the multipactoring threshold, the dees and the dee-stems are electrically insulated and biased with a negative voltage. Therefore, the dee-stems are terminated by electric capacitors. This cyclotron produces internal and external beams of 7.5 Mev protons, 15 Mev deuterons, and 30 Mev alpha particles. These beams are used for experiments on nuclear reactions and for producing radioisotopes. (auth)

19827 PRECISION SURVEY OF THE 28 Bev SYNCHROTRON IN THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH. A. E. Decae (CERN, Geneva). Empire Survey Rev., 16: 98-106; 146-60; 194-208(1961).

The accuracy required in the positioning of magnet units of the large CERN proton synchrotron imposed preliminary studies of the stability of the superficial ground and deep layers before designing the proper foundations. Repeated precise surveys carried out with a 0.1 mm accuracy brought to light periodic expansions of the subground (10^{-6} in relative size), connected with periodic tiltings (10^{-6} radians), both phenomena being indirect effects of Atlantic Ocean tides. These movements made it necessary to contrive elastic foundations for the magnets. The study of their stability, together with optical refraction considerations, led to the conception of the method to be used to position the units. A final accuracy of ± 0.125 mm rms was achieved around the 100 meters radius circle. Possible methods of surveys for future larger synchrotrons are considered. (auth)

19828 ENERGY SPECTRUM OF NEUTRONS SCATTERED INSIDE THE FRASCATI SYNCHROTRONE. R. Breschi, M. Ladu, and E. Rotondi (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Minerva nucleare, 6: 18-23(Jan. 1962). (In Italian)

The energy spectrum of neutrons scattered around the

electron-synchrotron was instigated by the nuclear emulsion technique. Beyond the shielding structures, the proportions of neutrons of more than 2 Mev in the biological dose is negligible. From the point of view of security, the value of 10 usually attributed to neutron RBE, leads to over-evaluation of the biological dose. (auth)

19829 PRODUCTION OF POSITRONS WITH THE STANFORD MARK III ACCELERATOR. D. Yount and J. Pine (Stanford Univ., Calif.). Nuclear Instr. & Methods, 15: 45-50(Feb. 1962). (In English)

A positron beam of intensity 7×10^6 positrons per pulse (60 pulses per second) has been obtained with the Stanford electron linac. The energy is 300 Mev and the energy spread is 2%. The method of production of the beam and the factors involved in maximizing the intensity are discussed. (auth)

19830 SECONDARY EMISSION BEAM MONITORS FOR 0.5 TO 3.5 Mev ELECTRONS. V. J. VanHuyse, E. D. Wattecamps, R. E. Van de Vijver, and G. J. VanPraet (Rijksuniversiteit, Ghent). Nuclear Instr. & Methods, 15: 59-62(Feb. 1962). (In English)

The performance and the properties of secondary emission monitors for electron beam intensity measurements in the energy region of 0.5 to 3.5 Mev are presented. Especially the efficiency as a function of the electron energy is studied. These monitors can be used as absolute monitors with an accuracy of 1% after calibration by comparison with a Faraday cup. (auth)

19831 A SOURCE OF POLARIZED IONS. J. E. Sherwood (Oak Ridge National Lab., Tenn.). Nuclear Instr. & Methods, 15: 103-11(Feb. 1962). (In English)

A preliminary model of a source of polarized ions has been built in order to evaluate the feasibility and limitations of such an apparatus as an accelerator source. A current of 10^{-4} μA of polarized deuterons has been produced and the alignment demonstrated by observation of anisotropic neutron yield from the $T(d,n)He^4$ reaction. Experimental problems are discussed. (auth)

19832 SUGGESTED NEW METHOD OF INJECTION INTO TWO TANDEM ACCELERATORS. F. A. Julian and A. C. Riviere (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 15: 115-16(Feb. 1962). (In English)

An injection method is suggested combining the advantages of both positive ion injection and the focusing effect of the first stage of acceleration, yet using low-velocity hydrogen atoms at the attachment canal. It is suggested that heavy positively charged molecular ions containing hydrogen nuclei in their structure should be accelerated by the first stage. Hydrogen atoms resulting from dissociation of the molecular ions by gas collisions in the attachment canal in the first center terminal would be free to form H^- ions. Further, by choosing molecular ions of appropriate mass and constituent atoms it should be possible to produce negative ions of heavier elements, such as oxygen and fluorine, in the same manner. (L.T.W.)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 18941, 18942, 18943, 19575, 19576, 19578, 19579, 19582, 19583, 19584, 19585, 19586, 19589, 19590, 19591, 19592, 19593, 19594, 19595, 19596, 19597, 19603, 19604, 19607, 19616, 19621, 19622, 19625, 19626, 19630, 19631, 19632, 19634, and 19635.

19833 (AD-267194) TRANSVERSE PINCH DYNAMICS. Richard H. Huddlestone (Aerospace Corp. Physical Research Lab., El Segundo, Calif.). Mar. 1, 1961. Contract AF04(647)-594. 24p. (TDR-594(1214-01)TR-1)

The dynamics of the initial phase of a nonadiabatic transverse pinch energized by a transmission line are studied in terms of a model for the plasma consisting of free particles colliding elastically with a moving interface. The initial temperature of the plasma as well as multiple collisions with the interface are neglected. It is shown that the pinching is well described by a simple approximation in which the nonlinear effects of changing pinch inductance and work done on the plasma are replaced by a constant effective load inductance. The accuracy of this approximation and the dependence of the dynamics on physical parameters are discussed. (auth)

19834 (AD-268799) THE LITERATURE OF PLASMA JET: THEORY AND APPLICATION FOR ATTITUDE CONTROL AND PROPULSION SYSTEMS. Barbara Ann Bryce (Autonetics. Div. North American Aviation, Inc., Downey, Calif.). Nov. 22, 1961. 49p. (EM-7516)

A bibliography of 461 references is presented which concerns the theory and experiments of plasma jets for attitude control of spacecraft and advanced propulsion systems (noncombustion power). Most of the annotated references were searched from current periodicals, 1960-1961. The six major sections, alphabetically referenced, include: Journals; ASTIA Reports; OTS and Library of Congress Reports; Theses, Patents and Papers; Meetings; and Books. The bibliography introduction includes information in reference to computer translation of Russian articles on plasma physics. An author index and combined source and corporate index follow the references. (auth)

19835 (AFCRL-62-222) CONFINEMENT OF A PARTIALLY IONIZED GAS BY A PERIODIC MAGNETIC FIELD. Report No. 62-2. Bert Zauderer (Massachusetts Inst. of Tech., Cambridge. Magnetogasdynamics Lab.). Jan. 1962. Contract AF19(604)-4551. 60p.

Experiments were performed to test the possibility of confining a partially ionized gas by a periodic magnetic field, so that the density of unionized gas in contact with the wall is small compared with the density of the magnetically confined plasma. In one set of experiments, an Ar plasma at 10000°K and about 20% ionization was produced in a 6 in. diameter combustion driven shock tube. When the plasma was inside a coaxial 14 in. diameter solenoid, a 67 kc magnetic field was turned on. When the static plasma pressure was less than the magnetic pressure, $B^2/2\mu_0$, a smear camera photograph showed periodic contractions of the plasma cylinder at a rate equal to twice the field frequency. From the smear photograph and magnetic probe measurements inside the shock tube it was concluded that the outer cm layer of the plasma was substantially heated and ionized by eddy current heating. When $p/B^2/2\mu_0$ was equal to 0.26, magnetic probes showed that the boundary of the ionized portion of the gas was located between 1.5 and 2.5 cm from the wall. Since the edge of the gas was highly ionized it was concluded that a large percentage of the gas was confined by the field. In another set of experiments, an electrodeless ring discharge was used to produce Ar plasma in the same experimental arrangement as in the previous experiments. Smear photographs showed that radial shocks were formed at the inside wall of the glass tube every half field cycle, and that they propagated toward the axis of the tube with velocities between 0.4 and 1.0 cm/μsec. The gas was estimated as being between 10000 and 20000°K. Magnetic probes inside the glass tube indicated that qualitatively the magnetic effects were similar to the first set of experiments and that the field was con-

fining the plasma. A similar ring discharge experiment in H led to the conclusion that the speed of sound divided by the tube diameter must be very small compared with the angular field frequency to obtain a steady continuous confinement. (auth)

19836 (AFCRL-549) CYCLOTRON-WAVE NONCONVECTIVE INSTABILITY. Scientific Report No. 14. A. W. Trivelpiece and B. J. Maxum (California. Univ., Berkeley. Electronics Research Lab.). July 1, 1961. Contract AF19(604)-2270. 17p. (AD-263777)

The cyclotron waves on oppositely directed interpenetrating electron beams or plasmas of finite transverse cross section in a finite axial magnetic focusing field interact to give a nonconvective or time growing instability. This instability, unlike the usual space-charge-wave nonconvective instability, is possible for physically realizable electron beams. If the d-c drift velocity of the two oppositely directed beams is slightly different, then a disturbance propagates in space as well as grows in time. In addition to the above instability, the space-charge waves of one beam can interact with the cyclotron wave on the other beam. (auth)

19837 (AFCRL-760) INSTABILITIES AND NOISE IN MAGNETICALLY CONFINED PLASMAS. Final Report, Period ending, August 31, 1961. M. Scotto, D. Denburg, and P. Parzen (Johns Hopkins Univ., Baltimore. Radiation Lab.). Contract AF19(604)-5468. 55p. (AD-265762)

Large amounts of noise power were observed in a coaxial line coupled to a magnetically self-confined plasma. The noise power lies in the megacycle frequency range, and has a power density of the order of 50 db/kt. To account for this, a theory is developed based on the inherent instabilities in the plasma, which are characterized by the propagation of initial disturbances in the form of growing waves. The mode of propagation depends on the transverse movement of the surface of the plasma, and is affected slightly by any action in the interior of the discharge. This type of propagation is similar to the scalloping modes in microwave tubes except for the presence of positive ions which are lacking in most microwave devices. The frequency at which the maximum growth occurs is determined by the gyro and plasma frequencies of the positive ions. (auth)

19838 (AFOSR-300) A MAGNETIC ANNULAR ARC. W. E. Powers and R. M. Patrick (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Mar. 1961. Contract AF49(638)-659. 15p. (AMP-54)

Experiments were carried out in a geometry where an arc was formed by a radial current in the annulus between two coaxial electrodes. The arc was used to heat a cold gas which was flowing in the axial direction in the annulus. There was an axial magnetic field throughout the flow region. The number density of the plasma was of the order of $10^{15}/cm^3$ to $10^{17}/cm^3$. The power levels of the arc were such that the average energy per particle was 2 to 3 ev. The strength of the axial magnetic field was from 4000 to 10,000 gauss, which was large enough to make the gyro radius of the electron smaller than their mean free path, i. e., $\omega_e\tau_e > 1$, where ω_e is the gyro frequency and τ_e is the average time between collisions. When $\omega_e\tau_e > 1$ the transport properties of the plasma are no longer scalar quantities, and Hall currents exist in the $\overline{j_r} \times \overline{B}_x$ (azimuthal) direction. The operation characteristics of this annular arc were calculated. The assumptions in the calculation include one-dimensional steady flow, uniform current density, and sonic axial velocity at the down-stream end of the arc. The variation of the electrical impedance of the arc with power level, particle density, and magnetic field strength was measured. These values are compared with the calculated values and indicate that the arc impedance is linearly dependent upon $\omega_e\tau_e$. The heat flux to the walls of the arc chamber was measured and compared with the theoretical value. The arc heated plasma is insulated from the walls because the density is high and collisions are sufficiently frequent so that energy can only diffuse to the walls from a very nearby region. The static and total pressure of the arc heated plasma were measured. These results were used to establish the plasma conditions, which must be used to obtain a preliminary comparison of the experimental results with theoretical predictions. (auth)

19839 (AFOSR-1441) THEORETICAL RESEARCH STUDIES OF REACTING PLASMAS. Final Report, June 1, 1959 through July 15, 1961. Guenther Ludwig (Berlin. Freie Universität). Contract AF61(052)-239. 7p. (AD-265446)

A theoretical study is presented for the derivation of a generalized application of the Boltzmann equation to the time evolution of plasmas. The concept is based upon the kinetic theory of gases which was extended through the use of statistical methods of measurements of particle probability densities. (auth)

19840 (GCA-TR-61-39-A) STUDY OF THE INTERACTION OF ELECTROMAGNETIC RADIATION AND HYDROMAGNETIC WAVES AND SHOCKS IN AN IONIZED MEDIUM. Final Technical Report. Donald H. Menzel, Carl A. Accardo, David Layzer, and Herbert K. Brown (Geophysics Corp. of America, Bedford, Mass.). Sept. 14, 1961. Contract AF 19(604)-7353. 116p. (AFCRL-766; AD-263530)

A review of the classical Bailey-Martyn theory of cross modulation (Luxembourg effect) is given. A theory is developed for electromagnetic waves in a plasma leading to a dispersion relation that depends explicitly on the velocity-distribution function f(q,t) of the electrons. The complex index of refraction is determined by the isotropic part of f, and a formula for the time-independent part of f is derived. The time-dependent part of the function is reduced to a problem of determining the solution of a pair of simultaneous second-order differential equations. A detailed discussion is given of the coupled pair of (quasi hypergeometric) differential equations. The magnetohydrodynamic interaction of a partially ionized gas with electromagnetic waves is considered and the resulting dispersion relation illustrates the coupling between mechanical and electromagnetic waves. (auth)

19841 (JPL-TR-32-126) THE EXPANSION OF A PLASMA COLUMN IN A LONGITUDINAL MAGNETIC FIELD. Ching-Sheng Wu (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). June 30, 1961. Contract NASw-6. 27p.

The expansion of an infinitely long plasma column in a longitudinal magnetic field was considered. An initial equilibrium condition was postulated. The plasma was assumed to have finite conductivity. The analysis was based on the one-fluid hydrodynamic theory. (auth)

19842 (ML-833) BEAM PLASMA AMPLIFIERS. M. A. Allen and G. S. Kino (Stanford Univ., Calif. Microwave Lab.). July 1961. Contract Nonr 225(48). 19p. (AD-263390)

Recent experiments on electron beam-plasma interactions were performed using a thermally generated cesium plasma. The experimental results obtained are in excellent agreement with the theoretical predictions. These experiments show that the possibilities of using this inter-

action for the amplification of microwaves may, in the future, provide significant advantages over the existing devices now available. There is a possibility of obtaining high efficiencies at high-power levels. Because no circuit is used, and because it may be possible to couple to the beam in radically new ways, millimeter wavelength amplifiers and oscillators based on beam-plasma interaction look promising. The problems involved in the design of such devices are discussed. (auth)

19843 (PIBMRI-959-61) THE INFLUENCE OF COMPLEX WAVES ON THE RADIATION FIELD OF A SLOT-EXCITED PLASMA LAYER. T. Tamir and A. A. Oliner (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Nov. 2, 1961. Contract AF19(604)-4143. 50p. (AFCRL-62-28)

A study of the near field of a magnetic line source located inside an isotropic plasma layer reveals an excited space wave and strong E mode complex waves corresponding to poles in the integral representation of the field solution. Under these conditions, the radiation field may be calculated by means of a Kirchhoff-Huygens integration over the pole contributions in the near field. This result is in excellent agreement with the accurate steepest-descent evaluation whenever the complex waves are dominant. Depending on its location in the steepest-descent plane, each pole contributes either a broad peak at broadside, or a sharp peak at an oblique angle. In the frequency range in which the plasma is opaque, the complex waves are spectral and yield a single radiation peak at broadside, and with small power. Also, surface waves may be present and contribute to the far field located near the plasma-air interface. When the plasma is transparent only leaky waves exist, the strongest of which accounts for a sharp major peak that closely corresponds to the critical angle obtained by geometrical optics. The weaker leaky waves may yield additional but minor peaks, or contribute at broadside only. The more practical case of a distributed source is also treated. Its solution is shown to be obtainable directly from that for the line source; the expression for the radiation pattern is then given by the product of the line source solution and that for the source distribution in the absence of the plasma layer. (auth)

19844 (R62SD13) EXPERIMENTAL STUDIES OF NON-EQUILIBRIUM IONIZATION IN AN MHD GENERATOR. F. A. Robben (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Feb. 20, 1962. Contract AF33(616)-7539. 56p.

Non-thermal ionization in a magnetohydrodynamic (MHD) generator was considered. Equations giving the conductivity and electron energy of a moving gas in a magnetic field were derived, assuming only elastic collisions for electron energy losses, and assuming that the ionization is in a pseudo-equilibrium with the electron temperature. A series of experiments were made which in the absence of a magnetic field demonstrated non-equilibrium conductivity but in the presence of a magnetic field indicated a large sheath voltage drop. It appeared though that the small conductivity observed with a magnetic field was due to non-equilibrium effects. (auth)

19845 (SRS(PPL)-103) CONJECTURES CONCERNING THE EXTERNAL CIRCUIT EQUATION IN THE PINCH PROCESS AND ITS RELATION TO THE PLASMIC DYNAMICS. J. L. Neuringer (Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.). Feb. 1958. 5p. (AD-267238)

The mechanical work rate was determined in terms of electrical quantities. The pinched circuit equation was developed. (M.C.G.)

19846 (CEA-tr-R-1475) OSCILLATIONS D'UN GAZ ÉLECTRONIQUE À L'ÉTAT DÉGÉNÉRÉ, AYANT UNE FONCTION DE DISTRIBUTION DE FERMI. (Oscillations of an Electron Gas in a Degenerate State, Having a Fermi Distribution Function). I. I. Goldman (Goldmann). Translated into French by B. De. Trezvinsky from Zhur. Eksptl'. i Teoret. Fiz., 17: 681-5(1947). 13p. (Includes original, 5p.).

The problem of oscillations of a degenerate electron gas was studied. A solution is given for the problem of the time behavior of the density perturbation with given initial conditions. The problem of the oscillations of the exp ($i\omega t$) type was also considered. (tr-auth)

19847 (FTD-TT-62-323) THE USE OF THE DOPPLER EFFECT FOR INVESTIGATING PROCESSES IN A GAS-DISCHARGE PLASMA. E. (Ye.) V. Zagoryanskaya and P. S. Kireev (Kireyev). Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 4, 163-17(1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12627.

19848 (FTD-TT-62-417) THE EFFECT OF A CONSTANT ELECTRICAL FIELD UPON THE STRIKING OF AN SHF PULSE DISCHARGE IN A GAS. S. M. Levitskii (Levitskiy) and V. S. Gvozdetskii (Gvozdetskiy). Translated from Radiotekh. i Elektron., 7: 133-41(1962). 14p.

The effects of constant electric fields on the behavior of super-high-frequency pulse discharges in air and Ar at 10,000 Mc were investigated. It was found that under certain conditions, the superimposition of electric fields increases the breakdown power of the discharge and decreases the share of pulses leading to breakdown of super-high-frequency channels. (J.R.D.)

19849 SPECTROSCOPIC STUDIES OF HELIUM AND ARGON PLASMAS PRODUCED BY ELECTROMAGNETICALLY DRIVEN SHOCK WAVES. A. J. Barnard, G. D. Cormack, and W. V. Simpkinson (Univ. of British Columbia, Vancouver). Can. J. Phys., 40: 531-9(May 1962).

An electromagnetic shock tube of new design was used to produce highly ionized helium and argon plasmas. The electron number density n_e was determined spectroscopically from line broadening and line shifts, while the temperature kT was found from the relative intensities of HeI and HeII lines and of AII and AIII lines, respectively. The spectroscopic values were compared with predictions from shock theory. It was assumed that the shock-heated plasma reached thermal equilibrium before the first spectroscopic measurements were made (in a time of order 1 μsec after the onset of luminosity). For helium, with a shock speed of 4.8 cm/μsec and an initial particle density of 1.2×10^{16} cm^{-3}, the spectroscopic temperature (3.7 ev) is in good agreement with the value expected from shock theory (3.8 ev). Line broadening indicates $n_e = 5 \times 10^{17}$ cm^{-3}, which is much higher than the shock theory value (1.5×10^{17} cm^{-3}). For argon, with a shock speed of 1.9 cm/μsec and an initial particle density 2.1×10^{16} cm^{-3}, the electron number densities ($8, 6 \times 10^{17}$ cm^{-3}) agree within the experimental errors, but the spectroscopic temperature (2.5 ev) is substantially lower than the shock temperature (3.3 ev). (auth)

19850 THE PARTICULAR STRUCTURE OF IONIZING SHOCKS. Soubbaramayer. Compt. rend., 254: 2135-7 (Mar. 19, 1962). (In French)

The study of the shock wave which ionizes a gas in the presence of the electromagnetic field was made by Lyubimov. The ionizing shock is considered as particular limits of the general magnetodynamic shock where the conductivity is a function of the thermodynamic variables. (tr-auth)

19851 SOME CONSEQUENCES OF ION SLIP IN A PLASMA FLOWING THROUGH A MAGNETIC FIELD.

A. Maitland (C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, Eng.). Nature, 194: 670-1(May 19, 1962).

The behavior of a conducting gas composed of neutral and charged particles and flowing along a duct through a uniform transverse magnetic field is discussed. A region of increased charged particle density and temperature is created at the magnetic field boundary, and a plot of the temperature distribution along the duct is given. Since the charged particle flow velocity is dependent on the Larmor radius and the collision frequency, the electric field induced by the charge flow probably will not be a linear function of the magnetic field strength. It is suggested that the output of a d-c magnetoplasmadynamic power generator can be increased by using a nonuniform magnetic field. (D.L.C.)

19852 CONCENTRATION OF CHARGED PARTICLES IN THE PLASMA OF AN ARC BURNING IN AN ATMOSPHERE OF ARGON AND HELIUM. V. F. Kitaeva, V. V. Obukhov-Denisov, and N. N. Sobolev. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 94-8(Feb. 1962).

The contours of Balmer lines H_α, H_β, H_γ, and H_δ are measured in 1- to 200-amp arcs in argon and helium. The experimental contours are compared with theoretical contours. This comparison permits determination of the concentration of charged particles in arcs in argon (2×10^{14} to 3×10^{16} cm^{-3}) and helium (4×10^{13} to 2×10^{16} cm^{-3}), at currents of 1 and 6 to 200 amp respectively. The low concentrations of charged particles existing in these arcs at low currents appear to be one of the basic causes of the nonequilibrium population of the levels. (auth)

19853 IONS IN ROTATING LIQUID HELIUM II. G. Careri (Università, Rome), W. D. McCormick, and F. Scaramuzzi. Phys. Letters, 1: 61-3(Apr. 15, 1962).

Positive or negative He ions are passed transversely or axially through cylinders of rotating He II. A voltage is applied in the direction of ion flow, causing a space-charge-limited current to flow. Neither the positive or negative axial ion flows, nor the positive transverse flow, are affected by the rotation (between 1 and 60 rpm). The negative-ion transverse flow is attenuated strongly by the rotation, however, and for this case the current-to-ion mobility ratio and the space-charge density are found as functions of the applied voltage. The results are interpreted in terms of the vortex line theory of rotation of superfluid He. (T.F.H.)

19854 RESONANT BEHAVIOUR OF A PLASMA SLAB-CONDENSER SYSTEM. P. E. M. Vandenplas (Ecole Royale Militaire, Brussels) and R. W. Gould. Physica, 28: 357-67(Apr. 1962).

The resonant behavior of a plasma slab placed in an infinite plane condenser was studied. The problem was characterized by the constant density (N) of electrons and by two lengths l and a. Two cases were considered: T (Kelvin) = 0 and a characteristic geometrical frequency $\omega_e \sqrt{1 - a/l}$ appears; and $T \neq 0$, the fundamental characteristic frequency is slightly altered and a discrete resonance spectrum $\omega_N^2 \cong \omega_e^2\{1 + [(2N + 1)^2\gamma\pi^2 r^2 D]/a^2\}$, (N = 1, 2, 3 . . .; r_D: Debye radius) is obtained. The last case is then compared to the study of a hot cylindrical plasma with constant N and $T \neq 0$. (P.C.H.)

19855 MAGNETOHYDRODYNAMIC WAVES IN PLASMA. E. Chvojková. Pokroky mat., fys. a astron., No. 5, 563-73(1960).

Discussion is given on a plasma that was caused to oscillate. The wave equation is obtained from basic equations and Maxwell's equations, and the state of the electromagnetic field is described. Laws for the various oscillations of plasma can be stated using the method described. (P.C.H.)

19856 STRUCTURE AND QUASI-STATIONARY STATE OF A HIGH EFFICIENCY TOROIDAL PINCH DISCHARGE IN HYDROGEN. U. Grossmann-Doerth (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 1290-1312(Dec. 1961). (In German)

The processes in a high-efficiency electrodeless ring discharge in hydrogen were investigated. It was shown that the phenomena in the discharge ignition, especially the conversion of the neutral gas into an almost completely ionized plasma, are understandable with simple theories. After attainment of complete ionization, a quasi-stationary state arises in which the plasma undergoes a high energy loss, which keeps the temperature practically constant at 5 ev. Only instabilities appear as loss processes. (tr-auth)

19857 MODULATED BEAMS IN A PLASMA WITH A MAGNETIC FIELD. E. Canobbio and R. Croci (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 1313-19(Dec. 1961). (In English)

The radiation emitted by a linear density-modulated beam of ions parallel to a steady magnetic field and by a straight beam perpendicular to the field into a nondissipative plasma is investigated. In both cases the energy output becomes infinite at the "ion" and "electron resonance frequencies." From the expression for the radiation of the beam which is parallel to the external magnetic field the energy loss of a single particle by Cherenkov effect is also derived. (auth)

19858 NUMERICAL INTEGRATION OF THE NON-LINEAR VLASOV EQUATION. G. Knorr (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 1320-8(Dec. 1961). (In German)

The Vlasov equation, i.e., the Boltzmann equation without collision term, was numerically integrated as an initial value problem together with the second Maxwell equation for a one-dimensional electron plasma with smeared-out ion background. The initial values were taken as a Maxwellian distribution in velocity space and a cosine distribution in position, resulting in a sinusoidal form for the electric field. The Landau damping of the total energy of the electric field turned out to be valid for times larger than those given by a formal estimation of the validity of the linear solution. For still later times, the decay rate of the electric energy is less than that given by Landau damping. The period of validity of Landau damping was computed by estimating the influence of the trapped particles. As a nonlinear effect the first harmonic of the electric field builds up within this period. The growth of the first harmonic is faster for larger wave numbers k. (auth)

19859 PASSAGE OF MICROWAVES THROUGH PLANE PLASMA LAYERS. K. Hain (Institut für Plasmaphysik, Garching, Ger.) and M. Tutter. Z. Naturforsch., 17a: 59-64(Jan. 1962). (In German)

The reflection and transmission of a plane electromagnetic wave propagating through a plane plasma slab with and without a static magnetic field are computed. (auth)

19860 ONE-DIMENSIONAL MODEL OF A MAGNETO-GASODYNAMICAL ENERGY CONVERTER. K. A. Lur'e. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 5, 3-9(Sept.–Oct. 1961). (In Russian)

This work examines the possible working conditions of a simple magnetogasodynamical structure consisting of an infinite channel between two conduction plates and through which channel a compressed conducting gas is moving. A homogeneous magnetic field is applied perpen-

dicular to the direction of the gas motion and parallel to the plates. During the passage of a gas through such a magnetic field an electric current arises in a direction perpendicular to the plates. If the plates are connected by a certain voltage, then one can obtain some useful power. On the other hand if a current is sent through the gas situated in a magnetic field, the gas flow can be held up. Such conditions correspond to power consumption, the energy being dissipated in the heating of the gas. The present work is concerned with the determination of conditions under which one may go from the generative region to the consumptive and back again. It is shown that during the presence of shock waves in the gas flow there can be no such change from one region to the other. (TTT)

19861 SOME PROBLEMS CONCERNING THE MOVEMENT OF A CONDUCTING VISCOUS GAS IN THE PRESENCE OF MAGNETIC AND ELECTRIC FIELDS. V. P. Shiblovskii. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 5, 10-15(Sept.–Oct. 1961). (In Russian)

The problem concerning the laminar flow of a gas between two infinitely long coaxial cylinders, rotating uniformly but with different angular velocities, is examined. If the gas possesses an electric conductivity different from zero and if electric and magnetic fields are applied to the flow, then the motion of the gas can be drastically changed. Two versions of the problem are examined. In the first, the electric field is radial while the magnetic field is axial. In the second version the electric field is axial and the magnetic field is annular and the vector is always parallel to the flow velocity. For both cases it is assumed that all characteristic parameters of the field and current depend only on the radial coordinate "r". Also, it is assumed that the viscosity of the gas and its electric conductivity are step functions of the heat content, and that the equation of state for the gas is of the form: $p/e = f(i)$, where "i" is the heat content. For set conditions of the given problems analytical solutions can be obtained. These solutions are then used to calculate several specific examples. (TTT)

19862 CONCERNING THE PREREQUISITES FOR THE EVOLUTION OF MAGNETOHYDRODYNAMIC FLOW. R. V. Polovin. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 6, 3-7(Nov.-Dec. 1961). (In Russian)

Limitations are investigated which govern the prerequisities for the evolution of the possible types of continual magnetohydrodynamic flow. As in ordinary hydrodynamics it is shown that a continual passage through the characteristic wave velocity accompanied by acceleration results in evolutionary flow. A passage accompanied by deceleration results in nonevolutionary flow. Also, in the case of continual magnetohydrodynamic flow for a finite profile, the passage of the velocity of the medium through the wave phase velocity, for small turbulences, can only occur when accompanied by acceleration. Conditions are also determined for the evolution of oblique magnetohydrodynamic shock waves and their relation to the value of the streamline angle. (TTT)

19863 CONCERNING NONSTATIONARY SPIRAL MOTIONS IN MANY-COMPONENT MAGNETIC HYDRODYNAMICS. V. S. Tkalich and E. F. Tkalich. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 6, 8-16(Nov.-Dec. 1961). (In Russian)

Various aspects of nonstationary spiral motions in many-component magnetohydrodynamics are described. The study is done for a plasma with a large volume; the velocity of the plasma is slow as well as slowly varying. Thus the processes of energy dissipation and heat exchange do not have to be considered. The Debye radius is small compared to the characteristic linear dimensions. The derived equations are then examined for two special cases: (1) potential motion of the plasma, i.e., the impulse is a harmonic function and (2) fixed motion. Equations for physical quantities are derived for the instance when moving waves are present in the plasma. These equations are simplified for particular conditions of the medium and of the magnetic field. Finally, plasmic agitations of an arbitrary profile are examined for the case when the magnetic field is directed along the axis of agitation. (TTT)

19864 ON THE ACCELERATION OF A PLASMA IN INTERSECTING ELECTRIC AND MAGNETIC FIELDS. V. M. Sarichev. Zhur. Priklad. Mekh. i Tekh. Fiz., 6: 17-23(Nov.-Dec. 1961). (In Russian)

The isothermal acceleration of a one-dimensional flow of a weakly ionized plasma in channels whose limiting angles are expanded by external, constant, intersecting electric and magnetic fields is examined. The region of importance is determined for nondimensional parameters related to the effective acceleration. Problems are solved in connection with plasma acceleration for uniformly expanding channels during maximum acceleration and during acceleration with a constant effectiveness. The maximum attainable Mach number is found for effective acceleration. In addition, problems are solved concerning the optimal acceleration of an anisotropic plasma in a uniformly expanding channel. For the acceleration of the plasma flow to extremely high velocities two basic requirements must be fulfilled: (1) sufficient power must be fed into the gas to ensure effective acceleration and (2) construction must be such that no heat dissipation occurs. (TTT)

19865 INVESTIGATIONS FOR THE OPERATION OF A PLASMATRON WITH AN AIR STABILIZED ARC. G. Yu. Daumov, M. F. Zhukov, and B. Ya. Smolyakov. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 6, 29-35(Nov.-Dec. 1961). (In Russian)

Experiments were carried out to investigate the operation of an electric arc, stabilized by air, in a plasmatron. The cathode was in the form of a glass, while the anode was a heavy-walled tube; both were constructed of copper. The electrodes were water cooled. During the experiments the following quantities were measured: (1) water and air consumption, (2) water temperature, and (3) arc current and the voltage drop on it. The measurements were carried out at an air pressure of about one atmosphere in the arc chamber. The voltages as a function of the arc current are shown in a series of curves, each representing a particular air consumption. It is concluded that in order to increase the region of arc stability the power supply voltage has to be increased. The data are in complete agreement with theory. The efficiency of the apparatus was measured as a function of the arc power. Stability was attained even up to 6000°K. At this temperature the efficiency of the plasmatron was found to be about 50%. (TTT)

19866 ONE-DIMENSIONALLY DETERMINED MOTION OF A PLASMA IN A CHANNEL WITH AN EXTERNAL MAGNETIC FIELD AND RESISTANCE. G. Yu. Daumov. Zhur. Priklad. Mekh, i Tekh. Fiz., No. 1, 5-11(Jan.-Feb. 1962). (In Russian)

One-dimensionally determined plasma flow with a constant electric conductivity and an ideal heat capacity has been examined previously in several works. In the present paper a method is derived for the solution of the equations applicable for the one-dimensionally determined plasma flow in a channel possessing resistance and an external magnetic field. The solution is carried out taking

into consideration dissociation as well as the change in conductivity as the flow proceeds through the channel. The derived system of equations can be solved by the use of an electronic computing machine. The problem concerning the motion of rapidly ionizing cesium vapors is solved, and the resultant solution is displayed in the form of graphs. (TTT)

19867 CONCERNING THE ISOTHERMAL ACCELERATION OF A ONE-DIMENSIONAL FLOW OF A PLASMA IN EXTERNAL, TRANSVERSE AND HOMOGENEOUS MAGNETIC AND ELECTRIC FIELDS. V. M. Sarichev. Zhur. Priklad. Mekh, i Tekh. Fiz., No. 1, 12-14(Jan.–Feb. 1962). (In Russian)

The isothermal acceleration of a plasma in external, transverse, and homogeneous magnetic and electric fields is examined on the basis of the applicability of one-dimensional equations of the complex type. The examination is carried out for two cases. In the first case the current density is constant throughout the channel; in the second, the channel has a constant angle of widening. Also, the isothermal acceleration of the plasma in a heat nozzle is discussed. This investigation is done for two types of dependence of the plasma conductivity on its density. (TTT)

19868 MAGNETOHYDRODYNAMIC PROBLEMS CONCERNING THE FIXED CONVECTION FLOW IN VERTICAL CHANNELS. S. A. Regirer. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 1, 15-19(Jan.–Feb. 1962). (In Russian)

The stationary magnetohydrodynamic problems concerning the convectional motion of a viscous conducting fluid in vertical cylindrical channels was studied. A class of exact solutions for convectional processes in magnetic fields of a general type is examined. The following specific cases are considered: (1) the vertical gradient of the temperature is zero; (2) the longitudinal current density "j" is zero; and (3) the fluid is an ideally conducting one. As an example, the convectional flow is examined for a circular cylindrical channel with the temperature gradient equal to zero; a longitudinal current, created by an azimuthal magnetic field, is allowed to pass through the fluid. (TTT)

19869 CONCERNING STATES WITH ANISOTROPIC DISTRIBUTION FUNCTIONS IN A RAREFIED RELATIVISTIC GAS. G. M. Zaslavskii and S. S. Moiseev. Zhur. Priklad. Mekh, i Tekh. Fiz., No. 1, 20-4(Jan.–Feb. 1962). (In Russian)

The number of states in a gas, which have an anisotropic distribution of velocities, is relevant not only to a plasma in a magnetic field during grazing collisions but also to a beam of charged particles traversing a plasma. These states are investigated for a relativistic gas. They are of particular interest in the relativistic case because the mean free path for particles is greater in a relativistic gas than in a nonrelativistic gas of the same density. Also, the energy loss of the particle during radiation depends substantially on their motion. The energy tensor is derived for an impulse with anisotropic pressure. Distribution functions are considered for various collisions. Finally, the influence of magnetic "braking" radiation is also discussed. (TTT)

19870 CONCERNING THE PARTICULAR SOLUTIONS OF THE HYDRODYNAMIC EQUATIONS OF A RAREFIED PLASMA IN THE CASE OF AXIALLY SYMMETRIC MOTION. V. P. Korobeinikov. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 1, 153(Jan.–Feb. 1962). (In Russian)

The equations for nonstationary motion of a rarefied plasma are presented for the case of cylindrical symmetry. These equations are simplified and discussed for two particular conditions. In the first instance the magnetic field in the axial direction is zero; in the second case the azimuthal and axial components of the magnetic field are not zero. The equations derived for the first instance indicate that when two of the arbitrary constants, B and C, are greater than zero, then (1) the portion of the plasma found at time zero at a finite distance away from the symmetry axis cannot disappear into infinity and (2) all the portions of the plasma cannot be compressed into an infinitely thin cord. (TTT)

19871 ON THE MAGNETIC FIELD TOPOLOGY. G. V. Skornyakov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 261-8(Mar. 1962). (In Russian)

Topological properties of magnetic fields are analyzed, and a method is offered for developing fields with assigned topology for plasma thermalization. (tr-auth)

19872 THE EXCITATION OF MAGNETIC SOUND WAVES IN RAREFIED PLASMA BY THE LOW OF CHARGED PARTICLES. A. B. Kitsenko and K. N. Stepanov. Zhur. Tekh. Fiz., 32: 303-7(Mar. 1962). (In Russian)

Excitations of fast and slow magneto sound waves in rarefied plasma by a charged particle beam were studied, and various cases of wave rise increments are found. (tr-auth)

19873 EXPERIMENTAL DEFINITION OF THE FREQUENCY OF ELECTRON COLLISIONS IN A DENSE PLASMA. A. I. Anisimov and N. I. Vinogradov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz., 32: 308-12 (Mar. 1962). (In Russian)

High-frequency signal (3600 Mc) attenuation was used for determining the frequency of electron-ion collisions in decomposing plasma. The measurements were made at low pressure (0.4 to 0.1 mm mercury) in helium and hydrogen plasmas with charged particle concentrations of 10^{12} to 10^{13} cm^{-3}. The collision frequencies are approximately proportional to the concentration of charged particles. (tr-auth)

19874 ELECTROMAGNETIC WAVES IN PLASMA IN THE REGION OF ION CYCLOTRON RESONANCE. L. S. Bogdankevich and A. A. Rukhadze. Zhur. Tekh. Fiz., 32: 322-8(Mar. 1962). (In Russian)

Studies were made of electromagnetic waves and magnetoactive plasma at ion cyclotron resonance frequency $\omega \sim m\Omega_i = (e_i H_0/Mc)$. A frequency region sufficiently removed from the resonance frequencies $\omega = m\Omega_i$ (where spatial dispersion of dielectric penetrability is weak) and a region in close contact with these frequencies (where spatial dispersion is stronger) were analyzed. Expressions were derived for wave refraction and absorption coefficients. It is shown that under certain conditions the ion absorption of electromagnetic field energy near the first and second resonance frequencies can be of considerable magnitude. (tr-auth)

19875 THE DISTRIBUTION OF THE TEMPERATURE AND ELECTRON CONCENTRATION IN THE SPARK DISCHARGE CHANNEL. V. F. Egorova, V. I. Isaenko, A. A. Mak, and A. I. Sadykova. Zhur. Tekh. Fiz., 32: 338-45 (Mar. 1962). (In Russian)

The intensity of spectral line emission and plasma continuum was utilized for determining the temperature and electron distributions in a spark channel at initial discharge stages and in various gases. The presence of Boltzmann distribution in a plasma spark was verified. (tr-auth)

19876 SPECTROSCOPIC MEASURING OF ION ENERGY ON ZETA TYPE INSTALLATIONS. A. N. Zaidel, O. V. Konstantinov, and G. M. Malyshev (Ioffe Inst. of

Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 32: 370-2(Mar. 1962). (In Russian)

The relation between ion energy and charge was analyzed, and the interpolated formula $E_i = \alpha Z$ showed that ion energy increases with charged number. The increase of ion energy with charge was also confirmed by investigations with alpha and zeta thermonuclear devices. Similar observations were made with a stellarator. The formula $E_i = E_o + (Mi_e/M_D)e$ reduces the deuteron temperature to ~100 ev, while ion acceleration by plasma electrostatic fields assumes deuteron temperature below the electron temperature, which is 20 to 30 ev (and is close to α in the above formula). (R.V.J.)

19877 METHOD AND APPARATUS FOR PRODUCING NEUTRONS AND OTHER RADIATIONS. James L. Tuck (to U. S. Atomic Energy Commission). U. S. Patent 3,037,921. June 5, 1962.

A neutron source is designed which comprises a toroidal chamber contained deuterium or tritium gas, means for ionizing said gas, primary coils located around said chamber for inducing an electrical current in said gas having a value high enough to produce a pinch effect, and electrical coil means for preventing the outward radial drift of the pinched discharge current. (AEC)

19878 HEAT TRANSFER AND TRITIUM PRODUCING SYSTEM. E. F. Johnson (to U. S. Atomic Energy Commission). U. S. Patent 3,037,922. June 5, 1962.

This invention related to a circulating lithium-containing blanket system in a neutron source having a magnetic field associated therewith. The blanket serves simultaneously and efficiently as a heat transfer medium and as a source of tritium. The blanket is composed of a lithium-6-enriched fused salt selected from the group consisting of lithium nitrite, lithium nitrate, a mixture of said salts, a mixture of each of said salts with lithium oxide, and a mixture of said salts with each other and with lithium oxide. The moderator, which is contained within the blanket in a separate conduit, can be water. A stellarator is one of the neutron sources which can be used in this invention. (AEC)

19879 CUSP-PINCH DEVICE. William R. Baker and J. P. H. Watteau (to U. S. Atomic Energy Commission). U. S. Patent 3,038,099. June 5, 1962.

An ion-electron plasma heating device of the pinch tube class is designed with novel means for counteracting the instabilities of an ordinary linear pinch discharge. A plasma-forming discharge is created between two spaced-apart coaxial electrodes through a gas such as deuterium. A pair of spaced coaxial magnetic field coils encircle the discharge and carry opposing currents so that a magnetic field having a cuspate configuration is created around the plasma, the field being formed after the plasma has been established but before significant instability arises. Thus, containment time is increased and intensified heating is obtained. In addition to the pinch compression heating, additional heating is obtained by high-frequency magnetic field modulation. (AEC)

19880 SUPERFAST THERMALIZATION OF PLASMA. Chieh Chien Chang (to U. S. Atomic Energy Commission). U. S. Patent 3,039,014. June 12, 1962.

A method is given for the superfast thermalization of plasma by shock conversion of the kinetic energy stored in rotating plasma rings or plasmoids colliding at near supersonic speeds in a containment field to heat energy in the resultant confined plasma mass. The method includes means for generating rotating plasmoids at the opposite ends of a Pyrotron or Astron containment field. The plasmoids are magnetically accelerated towards each other into the opposite ends of the containment field. During acceleration of the plasmoids toward the center of the containment field, the intensity of the field is sequentially increased to adiabatically compress the plasmoids and increase the plasma energy. The plasmoids hence collide with a violent shock at the center of the containment field, causing the substantial kinetic energy stored in the plasmoids to be converted to heat in the resultant plasma mass. (AEC)

Shielding

19881 (DC-60-7-119) A MONTE CARLO CALCULATION OF AIR-SCATTERED NEUTRONS. J. E. MacDonald, N. R. Baumgardt, and A. Trampus (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). July 26, 1960. Contract AT(11-1)-171. 51p.

Shielding Computer Program 16-0 calculates the neutron energy spectrum and angular distribution at an unshielded point detector due to multiply scattered radiation in a homogeneous infinite medium from a monoenergetic, monodirectional point source of neutrons. The events considered are: isotropic elastic scattering, anisotropic elastic scattering, inelastic scattering, radiative capture, and absorption without subsequent particle emission. Gamma rays born during the course of a neutron problem are recorded for future use in a gamma air-scattering program. The first collision portion of the problem is done analytically while higher order collision contributions are obtained by Monte Carlo methods. (auth)

19882 (TID-15419) SCATTERING OF GAMMA RAYS AND X-RAYS AND HIGH ENERGY ELECTRONS IN MATTER. A Bibliography. Gretchen R. Riese, comp. (Los Alamos Scientific Lab., N. Mex.). Sept. 11, 1957. Contract [W-7405-Eng-36]. 38p. (D-BIB-13)

A bibliography on scattering of gamma rays, x rays, and high-energy electrons in matter is presented. The 122 references covering the period 1943 to 1957 are arranged chronologically. (M.C.G.)

19883 (XDC-59-5-78) TEST DATA FROM THE 2π SOLID ANGLE SHIELD COVER EXPERIMENTS, PART 2. L. S. Burns (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 24, 1959. Contract [AT(11-1)-171]. 61p.

Experimental data taken with 2π shields between August and December 1958 are presented in graphs. The experiments were carried out to determine conditions necessary to make meaningful and useful measurements in and around a reactor crew shield system. The shields are described and diagrams given. Equipment and measurement methods are discussed. (M.C.G.)

19884 (XDC-60-1-215) A METHOD FOR COMPUTING A GENERALIZED EFFECTIVE FAST NEUTRON REMOVAL CROSS SECTION (MILESTONE 1, TASK 431311, JOB 51295). K. B. Hanchon (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 21, 1960. Contract AT(11-1)-171. 12p.

An analytical method for computing a generalized effective neutron removal cross section is given. Such a cross section can be computed from either a plane or a volume distributed source, and is specifically oriented toward a slab geometry. Since such a cross section is a function of backing material configuration, and of source-receiver distance, it could be used in the study of the effect of these variables on the removal cross section. Numerical examples are included. (auth)

19885 USE OF COLLIMATED NEUTRON BEAM SOURCES IN SHIELDING STUDIES (THE B-2 ASSEMBLY

OF THE BR-5 REACTOR). S. G. Tsypin. Atomnaya Energ., 12: 300-5(Apr. 1962). (In Russian)

Shielding theory does not provide designers with the required data because the quantitative properties of the elementary interaction processes between radiation and matter are not sufficiently well known; therefore, the theory must be supplemented by experiments. Special attention must be paid to the neutron and γ-ray sources used in these studies. A collimated, high-intensity neutron beam with a fission neutron energy of E > 2 to 3 Mev, obtained by means of the B-2 assembly of the BR-5 fast reactor, was used as neutron source in such shielding studies. The assembly consists of a channel, its gate valve, a moveable trolley, a tank, and the surrounding concrete shielding. The tests indicated that this unidirectional source is well suited for determination of the energy and angular distribution of neutrons within the shield. The effect of angular distribution of the radiation leaving the source on the attenuation of the beam in the shielding material could thus be satisfactorily determined. The great intensity of the beam produced by means of the B-2 assembly was found to present many experimental advantages, making it possible to determine the spectral distribution of fast neutrons in various media. (TTT)

19886 USE OF EMPIRICAL CONSTANTS IN SHIELDING CALCULATIONS. B. I. Sinitsyn and S. G. Tsypin. Atomnaya Energ., 12: 306-14(Apr. 1962). (In Russian)

Results of American, French, and Soviet experimental and theoretical studies on the use of neutron removal cross sections are critically reviewed. It was found that for hydrogenous media the neutron removal cross sections reported by G. Chapman and C. Storrs (AECD-3978, 1955) may be used if the spectrum of neutrons leaving the reactor is not too strongly altered in the 2 to 3 Mev region. An exception must be made for light elements, such as Be, B, and C, the removal cross sections of which increase in this region. The cross section data obtained experimentally for heterogeneous media may be used for calculation of homogeneous systems as the difference between elements does not exceed about 5 to 10%. They may be used also at any desired distance from the source because the absolute divergence remains within tolerable limits. The dose attenuation value of H may be used for approximate calculations. (TTT)

Theoretical Physics

19887 (ANL-6527) MANY-BODY THEORY (Based on a series of lectures given by J. R. Schrieffer). F. Bassani and J. Robinson (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-Eng-38. 86p.

Notes from a series of 15 lectures on many-body theory given at Argonne National Laboratory in the spring of 1961 are presented. Topics covered include: formalism of quantum field theory, Heisenberg and interaction representations, Green's functions in the many-body problem, perturbation expansion for Green's functions, high-density electron gas, and theory of superconductivity. (M.C.G.)

19888 (TID-15484) ANNUAL PROGRESS REPORT ON AND PROPOSAL FOR THE CONTINUATION OF THE RESEARCH PROGRAM IN THEORETICAL PHYSICS AT THE PUPIN LABORATORY UNDER CONTRACT AT(30-1)-1934. Period covered: June 1, 1962 – May 31, 1963. Robert Serber (Columbia Univ., New York). 17p. (CU-6-62-AEC 1934-Phys.)

Research progress is reported in the following fields: strong coupling theory, theory of high energy reactions, theory of weak interactions, atomic hyperfine spectra, a study of physical concepts, quantum field theory, high energy neutrino experiments and intermediate bosons, resonances in particle reactions, statistical mechanics of many boson systems, nuclear physics, and problems in solid state physics. (auth)

19889 ON TEMPORAL INVERSION. A. Galindo Tixaire (Junta de Energia Nuclear, Madrid). Anales real soc. españ. fís y quím. (Madrid), Ser. A, 57: 337-40(Nov.–Dec. 1961). (In Spanish)

The existence of antiunitary operators conjugating the dynamical group of any quantum system if rigorously proved, and the analysis of time reversal cyclicity is carried out by using minimal functional realizations of relativistic source spaces. (auth)

19890 ISOTOPIC GAUGE INVARIANCE OF A VECTORIAL FIELD OF ZERO EIGENMASS. Kuo-Hsien Tzou. Compt. rend., 254: 1210-12(Feb. 12, 1962). (In French)

In a compatible formalism, the interaction of a vector field of spin 1, of isotopic spin 1, and of zero eigenmass with the Yang and Mills field was established. The interaction considered is not simply "minimum" nor completely linear. (tr-auth)

19891 LORENTZ CONDITION AND COULOMB INTERACTION IN NON-LOCAL THEORY. Pham Xuan Yem. Compt. rend., 254: 1935-6(Mar. 12, 1962). (In French)

The canonical transformation which eliminates the longitudinal waves in nonlocal theory is sought. The new Coulomb interaction differs from that of the local theory only by the charge density which is nonlocal. (tr-auth)

19892 THE CENTER OF MASS MOTION IN A CONSERVATIVE GRAVITATIONAL THEORY OF WHITEHEAD'S TYPE. J. A. Dyer and A. Schild (Univ. of Texas, Austin). J. Math. Anal. and Appls., 4: 328-40(Apr. 1962).

For a gravitational theory based on action-at-a-distance in flat Minkowski space, a formulation is considered that is obtained from a single-action principle and that is Lorentz-invariant. The Lorentz invariance leads to relativistic momentum conservation laws; it is shown that these conservation laws preclude any secular acceleration of the classical center of mass of a multiparticle system. (T.F.H.)

19893 ON THE CONTINUATION OF ORTHOGONAL STRUCTURE ACROSS SURFACES OF DISCONTINUITY IN THE MOMENTUM-ENERGY TENSOR. Dominic G. B. Edelen (RAND Corp., Santa Monica, Calif.). J. Math. Anal. and Appls., 4: 346-51(Apr. 1962).

Considering a three-dimensional surface in the Einstein-Riemann 4-space in which the energy-momentum tensor has discontinuities but also has well-defined one-sided limits, the conditions are found under which the orthogonal structure of the energy-momentum tensor is continued across the discontinuity. Further, it is found that an Einstein-Riemann space that is empty except for a number of mechanical bodies of finite extent has metric structure throughout only if the discontinuities in the energy-momentum tensor satisfy certain conditions. (T.F.H.)

19894 CALCULATION OF CHANDRASEKHAR'S X- AND Y-FUNCTIONS FOR ISOTROPIC SCATTERING. D. F. Mayers (University Computing Lab., Oxford). Monthly Notices Roy. Astron. Soc., 123: 471-84(1962).

Numerical tables are given of $X(\mu)$ and $Y(\mu)$ $(0 \leq \mu \leq 1)$ for values of the parameter τ greater than unity. The method used in calculations is a combination of the numerical solution of the auxiliary equation for $J(\tau,\mu)$ and an iterative process. Tables are also given for the conservative case. (auth)

19895 A MODEL UNIFIED FIELD EQUATION. J. K. Perring and T. H. R. Skyrme (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 31: 550-5(Apr. 1962). (In English)

The classical solutions of a unified field theory in a two-dimensional space-time are considered. This system, a model of interacting mesons and baryons, illustrates how the particle can be built from a wave-packet of mesons, and how reciprocally the meson appears as a tightly bound combination of particle and antiparticle. (auth)

19896 A UNIFIED FIELD THEORY OF MESONS AND BARYONS. T. H. R. Skyrme (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 31: 556-9(Apr. 1962).

The way in which a nonlinear meson type of field theory may contain its own sources, and how these may be idealised to point singularities as in the conventional field theories of interacting linear systems, is formulated. The structure of the particle source in the classical theory is calculated, and some qualitative features of the interactions between these particles and mesons are described. (auth)

19897 THE SINGULARITIES OF THE t-MATRIX AFTER A CANONICAL TRANSFORMATION. R. Balian and M. L. Mehta (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys., 31: 587-99(Apr. 1962). (In English)

In the case of a pair interaction, a geometric interpretation for the variational equations of the canonical transformation method is given. A criterion is deduced to distinguish, among the solutions of the variational equations, the one that gives the lowest average energy in the quasi-particle vacuum. After this transformation, a t-matrix can be defined that is nonsingular if all quasi-particle energies are positive. (auth)

19898 A METHOD FOR THE INVESTIGATION OF EQUILIBRIUM CONFIGURATION IN THE DROP MODEL. S. Gallone (Università, Milan). Nuovo cimento (10), 22: 1093-6(Dec. 1, 1961). (In Italian)

One method for studying the equilibrium configuration consists in the direct expression of the equilibrium condition of the surface of the nucleus under the influence of surface tension and coulomb forces. This condition is $OH + \rho V = \text{const}$, at all points of the surface: O is the surface tension, H the mean curvature, V the coulomb potential, and ρ the electric charge density. An approximation method for the resolution of this equation, valid for the study of equilibrium configurations not too far removed from a rotation ellipsoid of larger radius a and eccentricity e, is given. (J.S.R.)

19899 APPLICATION OF BOGOLIUBOV'S [BOGOLYUBOV'S] CANONICAL TRANSFORMATION METHOD TO THE CALCULATION OF SPACE-TIME CORRELATION FUNCTIONS. D. Kisdi (Hungarian Academy of Sciences, Budapest). Phys. Letters, 1: 67-8(Apr. 15, 1962).

Large, weakly interacting, homogeneous fluids at the absolute zero of temperature are considered. The space-time correlation functions, the excited states, and the energies of these excited states are calculated for these systems, for both Bose and Fermi statistics. (T.F.H.)

19900 REMARKS ON THE PROLONGATION OF A SCATTERING AMPLITUDE IN THE COMPLEX ANGULAR MOMENTUM PLANE. A. Martin (CERN, Geneva). Phys. Letters, 1: 72-5(May 1, 1962).

A procedure is found for interpolating a scattering amplitude, whose value is known for certain physical values of the angular momentum. A method is given for making the interpolated amplitude unique and unitary. The interpolative procedure is used to find partial wave amplitudes satisfying Mandelstam representations, at a given energy. (T.F.H.)

19901 QUANTUM FIELD THEORIES AT SMALL DISTANCES. W. Guettinger and J. A. Swieca (Universidade, São Paulo, Brazil). Z. Naturforsch., 16a: 1265-89(Dec. 1961). (In English)

The behavior of the propagation functions of quantized field theories at small distances is investigated in connection with the problem of consistency of the perturbation theoretical renormalization scheme. An attempt is made to adapt the conventional Hamiltonian and S-matrix formalism to the renormalization concept in such a way that a finite theory of interacting physical (dressed) particles results which as a whole and at each step of approximation satisfies the axioms of the general structure theory of quantized fields, notably causality and positive definiteness. If the physical particles of a field theory with point interaction are extended objects owing to the extension of the cloud of virtual quanta in the physical states, then the theory admits of a finite formulation with the extent of the cloud introducing a natural, coupling-dependent built-in cutoff. The limiting case of a point-like cloud corresponds to physical particles which because of their strong self-interaction do not interact with one another. This case, corresponding to the zero coupling limit, represents the most singular one given by the theory. An increase of interaction or coupling implies an increase of the size of the cloud and a corresponding charge spread. Conversely, there cannot be interaction if there is no extended cloud and charge spread. Cloud and charge structure come in via causal form factors related to vertex parts and electromagnetic form factors, which however a perturbation theoretical scheme cannot take into account. (auth)

19902 THE CORRELATION BETWEEN INVARIANCE PROPERTIES AND CONSERVATION LAWS. Heinz Steudel (Arbeitsgruppe für Grundlagenforschung der Theorie der Teilchen und Felder, Deutsche Akademie der Wissenschaften, Berlin). Z. Naturforsch., 17a: 129-32(Feb. 1962). (In German)

A systematic classification, based on functional criteria, is given for the local conservation laws. Three kinds of conservation laws and current vectors are distinguished. While those of the first and third kind are well known, those of the second kind are rarely considered. The Noether method of deriving conservation laws leads to what one calls proper current vectors of the first kind, from which all other current vectors of the first kind may be derived by adding some current vector of the third kind. Between the proper current vectors of the first kind and the invariance properties of the Lagrangian there exists a one-to-one correlation. The conservation laws of the second kind are not in this way related to invariance properties, but their significance is strongly restricted by Fletcher's theorem. The results obtained are used tn an attempt to shed some light on the problem of the electromagnetic field in the Heisenberg nonlinear spinor theory. (auth)

19903 AN EXPANSION OF THE FIRST NOETHER LAW. Heinz Steudel (Arbeitsgruppe für Grundlagenforschung der Theorie der Teilchen und Felder, Deutsche Akademie der Wissenschaften, Berlin). Z. Naturforsch., 17a: 133-5(Feb. 1962). (In German)

If an infinitesimal transformation of coordinates and field quantities is such that the Lagrangian density L is multiplied by a constant factor, there is a current density j^ν satisfying the equation $\partial_\nu j^\nu = L$ as a result of the field equations. Application of this theorem to potential theory yields a well-known equation. Application to the Heisenbergs nonlinear spinor theory yields an equation identical with the conservation-theorem derived by using a scale transformation with λ treated as fifth variable. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 19032, 19324, 19325, and 19329.

19904 (AAEC/E-84) A TABULATED FUNCTION ASSOCIATED WITH DOPPLER BROADENING FOR NON-UNIFORM SPATIAL TEMPERATURE DISTRIBUTIONS. A. Reichel (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1962. 30p.

A table to five decimal places is given for the function $\chi(x,\xi,\tau) = (\xi/2)\sqrt{\tau+1}\int_0^\infty e^{-p^2}\{\tan^{-1}[x+(2p/\xi)] - \tan^{-1}[x-(2p/\xi)]\}\,\mathrm{erf}(p/\sqrt{\tau})dp$. A function of this form arises in consideration of effective resonance line shapes, when, in heterogeneous reactor systems, a parabolic temperature distribution exists across the fuel lumps. The parameter ranges are: $x = 0\ (5)\ 60\ (10)\ 200$; $\xi = 0.05\ (0.01)\ 0.1\ (0.1)\ 0.5, 1$; and $\tau = 1, 1.5, 2, 5, 10, 50, 500$. (auth)

19905 (AEEW-R-77) STAB: A KINETIC, THREE-DIMENSIONAL, ONE-GROUP DIGITAL COMPUTER PROGRAM. A. R. Curtis, J. G. Tyror, and H. E. Wrigley (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1961. 45p.

A computer program for solving the one-group, time dependent, three-dimensional diffusion equation together with auxiliary equations representing heat transfer, xenon production, and control rod movements, is presented. The equations and the methods of solution are discussed. (auth)

19906 (AERE-M-1011) AN ESTIMATE OF THE NEUTRON FLUX DEPRESSION AND NUCLEAR HEATING IN THE CATHODE OF A PLASMA DIODE FUEL ELEMENT. L. G. Sanders (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 12p.

A cylindrical configuration is theoretically considered for use as the fissile cathode of a plasma diode fuel element to operate at about 2000°C. The cathode considered is a solid solution of UC/ZrC. The neutron flux depression for the fuel element is expressed by the ratio of the average flux in the cathode to the value at the cathode surface. Results are presented and are thought to be useful as a pointer in considering the dimensions, enrichment, and composition of practical diode reactor fuel elements. (J.R.D.)

19907 (CENRD-163) REACTOR KINETICS. Edward C. Toops (Combustion Engineering, Inc. Naval Reactors Div., Windsor, Conn.). Mar. 1961. Contract AT(30-3)-519. 16p.

The inhour equation was derived using the bare core approximation and few group diffusion theory. The method can be used for any reasonable number of groups. Simple analytical expressions for the prompt neutron lifetime are given for two, three, four, or more neutron groups. Different constants were used for the prompt fast and delayed neutron energy groups. The effective delayed neutron fraction is shown to be numerically equal to the "delayed multiplication constant" times the delayed neutron fraction. The expressions are suited to hand calculation for the interpretation of critical experiments or the analysis of reactor transients for safeguard studies. (auth)

19908 (DC-59-5-86) USE OF MAXWELL'S INFLUENCE COEFFICIENTS IN FUEL ELEMENT ANALYSIS. Structural Memo No. 22. D. R. Riley (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 30, 1959. Contract AT(11-1)-171. 29p.

Equations were developed for the structural analysis of a concentric ring fuel element assembly. The loading conditions covered by the equations are explained. The method of setting up the equations for calculation of deflections for stresses in the assembly is outlined. The capabilities of the single cylinder and the concentric ring assembly IBM programs are described. (auth)

19909 (HW-71260) COMPILATION OF DECONTAMINATION DATA: SUPPLEMENT TO PROGRESS REPORTS HW-67937 AND HW-71259. A. P. Larrick, R. B. Richman, and R. D. Weed (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 16, 1962. Contract AT(45-1)-1350. 70p.

A compilation is presented to serve as a detailed reference supplementing summary progress reports on decontamination at Hanford. The compilation contains no conclusions; these are contained in the summary progress reports HW-67937 and HW-71259. (J.R.D.)

19910 (HW-SA-2578) MULTIPLE SELF-SHIELDED BURNABLE POISONS FOR REACTOR CONTROL (thesis). Garrett John Busselman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1962. Contract [AT(45-1)-1350]. 43p.

Submitted to Univ. of Idaho, Moscow.

A generalized reactor fuel burn-up code, MELEAGER, was extended to treat self-shielded burnable poisons. A study of mechanical control minimization was carried out for a single reactor. B^{10} was used as a poison in both self-shielded and unshielded forms. Combinations of two different self-shielded boron burnable poisons were found to yield the most satisfactory reactivity response. Unshielded europium, both alone and with self-shielded B^{10}, was tried with mediocre results. (auth)

19911 (HW-SA-2586) AN ANALYSIS OF THE EFFECTS OF FAST NEUTRON-INDUCED FISSION IN A TWO-REGION NUCLEAR REACTOR FUEL ELEMENT (thesis). John Richard Lilley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1962. Contract AT(45-1)-1350. 91p.

Submitted to the Univ. of Idaho, Moscow.

The effects of fast neutron-induced fission in a two-region nuclear reactor fuel element were computed, assuming that the average fission neutron behavior can be represented by a single group of neutrons. This theory was then applied specifically to a coolant-filled fuel tube. A method for calculating average parameters for the single neutron group was derived, which yielded information about fast fission in a one-region fuel element. This theory yielded results for solid uranium metal and oxide rods which agreed well with experimental results. The two-region analysis, when applied to a group of multi-region experiments, gave good agreement with measurements. The error introduced by treating the fuel tube as a homogeneous fuel-coolant mixture was found to be of the same order of magnitude as the experimental error. (auth)

19912 (IDO-16738) CRITICAL PATH SCHEDULING OF ETR AND MTR REACTOR SHUTDOWNS. R. T. Jacobs and L. L. Myers (Philips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Jan. 10, 1962. Contract AT(10-1)-205. 29p.

Critical Path Scheduling (CPS) has furnished a systematic

method for planning shutdown projects and scheduling the use of available manpower for MTR and ETR reactor shutdowns. Answers to the following questions about shutdown projects are answered objectively: (1) What jobs follow, precede, or can be done concurrently with any other job in the whole project? (2) What will be the length of the shutdown? (3) What jobs, crafts, or equipment are critical to the over-all shutdown time? (4) How long can other noncritical jobs be extended or delayed without affecting the shutdown time? By following CPS, possible differences of opinion are narrowed down to only two things: sequential relationships of one job to another and estimated job duration time. (auth)

19913 (NAA-SR-6488) MOLTEN PHOSPHATE REACTOR FUELS. V. DESIGN AND CONSTRUCTION OF A VACUUM-LOCK, INERT-ATMOSPHERE DRY BOX. W. S. Ginell, M. A. Hiller, L. F. Grantham, and T. L. Young (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1962. Contract AT (11-1)-Gen-8. 25p.

The general design and construction of a stainless-steel, inert atmosphere box is described. Special features such as the gas purification system, dew point measurement apparatus, automatic pressure control system, and vacuum air lock are described in some detail. The box was operated routinely at impurity levels of 0.1 to 0.5 ppm by weight of water in argon. (auth)

19914 (ORNL-TM-224) HRT-CHEMICAL PLANT RUN 21 SUMMARY. O. O. Yarbro (Oak Ridge National Lab., Tenn.). Feb. 12, 1962. Contract [W-7405-Eng-26]. 15p.

The multiple hydroclone system removed 183 grams of corrosion product solids in 1814 hours of operation during reactor run 21. The low removal rate was attributed to plugging of multiclone feed ports that presumably occurred during the latter part of run 20. After modifications to the reactor core and removal of the multiclone unit at the end of run 21, the reactor core was backflushed with the flow direction in the core loop reversed. During this period, the single hydroclone removed 205 grams of solids in 10.5 hours of operation. (auth)

19915 (ORNL-TM-228) MEASUREMENT OF XENON POISONING IN THE HRT. W. D. Burch (Oak Ridge National Lab., Tenn.). Apr. 19, 1962. Contract [W-7405-eng-26]. 18p.

Measurements obtained during three periods of HRT operations indicated that the xenon poison fraction was approximately 0.010. The technique used was based on mass spectrographic analyses of the stable xenon isotopes in the reactor off-gas stream. Models proposed to explain the measurements show that xenon, which is formed primarily by decay of iodine adsorbed on the pipe walls, is held up on the walls, out of the circulating stream, for an average period of about eight hours. (auth)

19916 (TID-15646) REACTOR KINETICS ANALYSIS BY AN INVERSE METHOD (thesis). Carrol Reid Bingham (North Carolina State Coll., Raleigh). 1961. 83p.

A method of determining reactor transient behavior by finding the applied reactivity needed to yield any given power function is proposed. Tables were developed for the applied reactivity needed, called the reactivity transform of the power function. The method allows solution in closed form of many problems not usually soluble. Temperature and delayed neutron effects on reactor behavior are discussed. The possibility of finding approximate solutions to the nonlinear transient equations by the inverse method is demonstrated. Direct application of the reactivity transform in the field of reactor operation is suggested. (auth)

19917 (TID-15665) NUCLEAR REACTOR SIMULATION EXPERIMENTS (thesis). Thomas Wesley Kerlin, Jr. (Tennessee. Univ., Knoxville). Aug. 17, 1959. 163p.

A series of 9 nuclear reactor simulation experiments were developed to be performed on an analog computer. Analog computer and nuclear reactor fundamentals are discussed. Experimental procedure is outlined. The experiments include: introduction to the computer; reactor analysis, effect of delayed neutrons; reactor kinetics, analysis for three different fuels; regulating rod calibration; subcritical reactor behavior; xenon poisoning; nuclear power plant, program for constant average reactor temperature; nuclear power plant, program for constant steam temperature; and temperature coefficient of reactivity. (M.C.G.)

19918 (UNC-5007) SIMPLIFIED METHODS OF PREDICTING TEMPERATURE TRANSIENTS IN A FAST REACTOR POWER EXCURSION. Arthur J. Goldman (United Nuclear Corp. Development Div., White Plains, N. Y.). Apr. 15, 1962. Contract AT(30-1)-2832. 127p.

Approximations, for the purpose of predicting local and average temperatures in the core of a fast reactor during power excursions, were developed and evaluated. Simplified forms of the heat conduction equation in a cylindrical fuel rod and the energy equation in flowing coolant are presented. These were used to predict transients in a selected test case problem, and were evaluated by comparing the results with exact solutions. All of the simplifications considered were found to be adequate for slow delayed critical power transients. Some of them appear acceptable for medium and rapid transients. (auth)

19919 (WAPD-TM-285) INELASTIC DEFLECTION AND BUCKLING OF FUEL PLATES DUE TO FLUID VELOCITY AND COMPRESSIVE EDGE LOADS. D. S. Griffin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-Gen-14. 32p.

Fuel plates in long parallel-plate assemblies may be subjected to biaxial compressive forces in the plane of the plate and a transverse pressure induced by a differential fluid velocity in the two adjacent channels, causing the plate to bend out of its plane. If the velocity and compressive forces are sufficiently large, adjacent plates may bend enough to cause a thermal failure of the assembly. Using inelastic plate theory, deflections were derived and the interaction equations obtained for systems of loads which will cause "failure." (auth)

19920 (XDC-59-6-220) PROGRAM C_5–DIRECT AND ADJOINT BARE REACTOR PROGRAM–MULTIGROUP CONSTANT GENERATOR. P. G. Fischer, F. D. Wenstrup, and R. A. Pastore (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). May 13, 1959. 92p.

The programming techniques and input and output for an IBM 704 digital computer program for computing direct and adjoint lethargy dependent fluxes for a bare homogeneous reactor are described. Input data specifies the material and geometrical configuration of the reactor with cross section data obtained normally from the Nuclear Data Tape, although cross section input from cards is optional. Principle output consists of flux and adjoint "weighted" energy-group parameters and system multiplication. The energy-group parameters are obtained by three "weighting" procedures where applicable: direct flux, adjoint flux, and combined direct and adjoint weighting.

Program C_5 was programmed using the FORTRAN system of automatic coding, for the IBM 704, and is essentially an extension of Program C_4 now in production use. (auth)

19921 (FTD-TT-62-376) INVESTIGATION OF THE ASSEMBLY OF URANIUM RODS IN THE BR-5 REACTOR. V. I. Galkov, V. I. Ivanov, G. N. Smirenkin, and A. P. Smirnov-Averin. Translated from Atomnaya Energ., 12: No. 1, 56-7(1962). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11164.

19922 PRESSURE SUPPRESSION CONTAINMENT. W. L. Fiock (General Electric Co., San Jose, Calif.). Atomics, 15: No. 2, 21-4(Apr.-June 1962).

The design, testing methods, and performance of the pressure suppression containment which acts as a barrier to the release of fission products from a reactor are described. The Transient Test Facility is used to describe tests with materials representative of fission products in order to evaluate the effectiveness of the pool around the system. The initial test results show that the suppression pool will retain a significant fraction of suspended and soluble material associated with a steam-air mixture transient, and therefore will make a contribution to minimizing the potential escape of fission products from such reactor containment systems. The fission products are vented into the water pool from a dry well which contains the reactor. (N.W.R.)

19923 CALCULATION AND MOCKING-UP OF OPTIMIZED HOMOGENIZED-CORE REACTORS (AGE APPROXIMATION). L. A. Vulis, A. A. Kostritsa, and V. D. Kubyshkina. Atomnaya Energ., 12: 283-91(Apr. 1962). (In Russian)

Reactors having a minimal critical mass and with an uneven distribution of fuel, absorber, and moderator have been studied by several authors by means of the group method. These questions may be considered advantageously by making use of the Fermi age theory. Calculations of such reactors with a minimal critical mass and constant fuel density derived from the redistribution of the absorber are presented. A combination of analytical methods and of mocking-up make it possible to solve this problem within the framework of the Fermi age theory. Such a solution of problems of homogenized thermal neutrons proves that it is not necessary to simplify the Fermi age equation and to make use of the group theory for this purpose. (TTT)

19924 REPLACEMENT OF A LATTICE BLOCK NEAR THE REFLECTOR. L. Trilfaĭ (Inst. of Nuclear Studies, Czechoslovak Academy of Sciences, Prague). Atomnaya Energ., 12: 292-9(Apr. 1962). (In Russian)

The need arises occasionally for the replacement of a unit lying in the boundary region between the core and the reflector. In order to clarify the problems involved, the question of replacing the block within a semi-infinite two-dimensional square lattice near the boundary region by another block with different physical properties has been considered. The problem was mathematically reduced to a Riemann equation with a unique curvature in the plane of complex numbers. The neutron density at the surface of the blocks in the core was determined; however, the equations derived require lengthy computations. The problem becomes much simpler if only the neutron density around the replaced block is taken into account. No special assumptions were made concerning the nature of the exchange and the diffusion of the neutrons. (TTT)

19925 EFFICIENCY OF A CONTROL SYSTEM IN A REACTOR PROVIDED WITH A REFLECTOR, TAKING THE EPITHERMAL ABSORPTION INTO ACCOUNT. V. I. Nosov. Atomnaya Energ., 12: 326-9(Apr. 1962). (In Russian)

In the past, the efficiency of absorbing rod systems has been determined by means of a two-group approximation without having considered the epithermal neutron absorption; in other cases only unreflected reactors have been studied. For several reasons, such approximations are not sufficient; therefore, the efficiency of the rod system has been studied for a reactor with a radial reflector, under consideration of the epithermal absorption by making use of a three-group approximation. Equations were set up and the criticality conditions were derived by limiting the solution by means of a k-th order approximation. A set of $3(k + 1)$ similar algebraic equations was obtained, defining $3(k + 1)$ unknowns. The efficiency of the absorbing rod system is defined by the difference in the values of $k_{effectiv}$ in the presence and in the absence of the rods; similar calculations were used for reflected reactors. In case of small rods, a zero-order approximation is sufficient while for large rods the higher-order members must also be taken into account. (TTT)

19926 EFFECTIVE BOUNDARY CONDITIONS AT THE SURFACE OF A FLAT, PERIODIC LATTICE. V. V. Khromov. Atomnaya Energ., 12: 329-31(Apr. 1962). (In Russian)

The introduction of absorbing rods into the reactor core or the reflector represents one of the usual reactor control methods. While determining the efficiency of such systems, it is often desirable to disregard their heterogeneous character, ascribing an effective "grayness" value to the control units and using this value as an index of the average neutron field at points far removed from the absorbing lattice. This problem was mathematically solved for the case of an unlimited, flat lattice of absorbing plates having infinite lengths, considering the plates as "black". The lattice was considered immersed into a homogeneous infinite, isotropically scattering field in which external sources create a stationary field of monoenergetic neutrons, considering the medium as being nonabsorbing. Solution of the equations yields a q_0 value, corresponding to a homogeneous "gray" plate with a given "transparency". Results of the approximate calculation do not deviate from the precise values by more than 0.5%. (TTT)

19927 REACTOR CONDITIONS FOR MAGNOX ELEMENTS. M. T. Kavanagh (United Kingdom Atomic Energy Authority, Risley, Eng.). Atomwirtschaft, 7: 167-9(Mar. 1962). (In German)

The progress made in demonstrating the endurance capability of natural uranium, magnesium-alloy-clad fuel elements is reviewed. The program of devising and proving metallurgical and manufacturing modifications to the standard design of Calder Hall fuel elements is described. The difference in fuel elements for power reactors and Calder Hall fuel elements is discussed. Irradiation testing and post-irradiation examination is described. (M.C.G.)

19928 FUEL ELEMENTS WITH HIGH BURN-UP RATES. Marcel Englander, Jeanne Lehmann, Henri Ollier, Jacques Stohr, and Marc Salesse. Compt. rend., 254: 1635-6(Feb. 26, 1962). (In French)

Fuel elements of uranium alloyed with 1% molybdenum were irradiated in the EL-3 reactor of Saclay. Examinations (sampled with time) have shown that a burn-up rate of 10,000 Mwd/t was obtained without noticeable deformation. (tr-auth)

19929 STABILIZED TEMPERATURE DISTRIBUTION IN THE CYLINDRICALLY SYMMETRICAL UNIT CELLS

OF HETEROGENEOUS REACTOR CORES IN THE CASE OF CONVECTIVE HEAT TRANSFER. G. Német, K. Raszl, L. Szabados, L. Szeghoe, and A. Toeroek. Energia és Atomtech., 14: 560-5(Dec. 1961). (In Hungarian)

In order to be able to improve the operational characteristics of a reactor and to ensure safe dimensions in the design, the exact heat distribution within the unit cell must be ascertained. In the past, for reasons of simplification, the axial heat conductivity was usually neglected or it was assumed that the radial heat distribution is known. In order to improve the data reported in the literature, the differential heat conductivity equation was solved for the case of finite and infinitely long cylindrical fuel elements without assuming an a priori knowledge of the axial heat distribution in the coolant. This exact solution was then compared to data obtained by neglecting the heat conductivity in the axial direction, thus demonstrating on a numerical example the errors arising from the use of the approximation method. An experimental pressurized water reactor was used as the example. (TTT)

19930 AN INVESTIGATION OF THE FLUX DISTRIBUTION IN A BRANCHED THERMAL COLUMN. C. G. James and D. A. Meneley (Imperial Coll. of Science and Tech., London). J. Brit. Nuclear Energy Soc., 1: 103-8 (Apr. 1962).

Investigations are described of the neutron flux distribution in a horizontal graphite thermal column with a short vertical stub near the end remote from the neutron source. It is shown that by introducing large voids in the column and stub the spatial distribution of flux at both vertical and horizontal access may be adjusted and, if desired, made symmetrical. At the same time the magnitude of the flux at both faces is greatly increased over that for a similar solid column, by factors of up to 80. Computer calculations relate the fluxes observed using a 500 mC radium beryllium source to the fluxes expected when the neutron source is a reactor core, particularly of the swimming pool type. (auth)

19931 FLUX SUPPRESSION AS MEASUREMENT FOR THE EFFICIENCY OF AN ARBITRARY CONFIGURATION OF ABSORBER RODS IN A HOMOGENEOUS CYLINDRICAL REACTOR. H. Kiesewetter (VEB Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin-Pankow). Kernenergie, 5: 14-18(Jan. 1962). (In German)

This report connects a study by Kohler on a modified one-group theory with a work by Murray et al. on the efficiency of arbitrary arrangements of control rods. The formula obtained, which describes the efficiency of a random rod configuration, is in complete agreement with the Murray formula. The purpose of the article is to report some modifications in the description and the basic concepts. The work is divided into two parts. In this first section the boundary conditions of the modified Kohler one-group theory are considered. The second section will deal with the efficiency of an arbitrary rod configuration in a homogeneous cylindrical reactor. (tr-auth)

19932 CALCULATION OF A CELL CONTAINING CONTROL RODS. B. Koehler (VEB Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin-Pankow). Kernenergie, 5: 19-21(Jan. 1962). (In German)

The introduction of a mean flux curvature and a mean diffusion constant for a cell containing control rods expands the applicability of the cell method to cases in which the neutron current through the cell walls must not be neglected. (tr-auth)

19933 THE PREDETERMINATION OF THE LIFE TIME OF FUEL ELEMENTS OF A REACTOR. F. W. Krueger (VEB Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin-Pankow). Kernenergie, 5: 22-7 (Jan. 1962). (In German)

Under fixed idealized assumptions on the mechanism that leads to a fuel element defect, it is possible to calculate the presumable life of fuel elements by statistical methods. For ceramic elements the fundamentals and the procedure for such calculations are shown. (tr-auth)

19934 REACTOR CONTAINER. (to Deutsche Babcock & Wilcox-Dampfkesselwerke A. G.). German Patent DAS 1,093,497. Nov. 24, 1960. Kernenergie, 5: 65(Jan. 1962). (In German)

In water cooled reactors, welding was found to be very dependable for making a seal between the pressure vessel and the deck. Such welding has the disadvantage that it is only usable when the radiation level is so low that no danger results from working on the seal. If the radiation level at the connection between vessel and deck is so high that a seal cannot be made, then, according to the patent, the reactor vessel and deck were extended by collar or flange in order to make the weld outside the shield. It is possible under all foreseeable conditions to make a sealed connection between the pressure vessel and deck. Mechanical coupling of the deck with the vessel can be made with a bayonet seal or with special supplementary coupling elements. (J.S.R.)

19935 DEVICE FOR THE CIRCULATION OF THE COOLANT IN A DOUBLE-WALLED REACTOR. (to Brown, Boveri & Cie A. G. and Beteiligungs- und Patenverwaltungsgesellschaft m.b.H). German Patent DAS 1,092,138. Nov. 3, 1960. Kernenergie, 5: 65(Jan. 1962). (In German)

A device is described for circulating coolant in a double-walled reactor. An impeller for circulating the coolant is operated by a motor outside the exterior walls by a jointed shaft that compensates for heat expansion in the walls. (J.S.R.)

19936 DEVICE FOR LOADING CIRCULAR CHANNEL SYSTEMS IN INSTALLATIONS SUCH AS NUCLEAR REACTORS. (to Deutsche Babcock & Wilcox-Dampfkesselwerke A. G.). German Patent DAS 1,084,391. Nov. 24, 1960. Kernenergie, 5: 65(Jan. 1962). (In German)

In reactors the tubular fuel elements are arranged at a given lattice spacing parallel to each other in circular channels or fuel element channels, which are horizontal or perpendicular. So that the fuel elements in the tubes can be exchanged, there must be passage through the container wall. This creates difficulties with respect to the construction since in the usual lattice arrangement the tubes lie very close to each other and weaken the stability of the container. In this patent a device for loading bore hole systems is described. A movable, rotary device is superposed on the inlet tube of the container wall. The placement of the device can be monitored through the use of television and therefore controlled. (J.S.R.)

19937 METHOD FOR THE OBSERVATION, MEASUREMENT, AND STANDARD CONTROL OF THE REACTOR TEMPERATURE. German Patent DAS 1,093,501. Nov. 24, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

According to the patent, the thermal radiation of thermally charged constituents of a reactor is used for temperature control of the reactor. This radiation is converted by means of heat-sensitive image converters into individual electronic images and transformed into an optically or electronically transmittable image. The images thus obtained are approximately proportional to the temperature. (J.S.R.)

19938 FLANGE-LIKE SPACER. (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,086,356. Aug. 4, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

Foil spacers are described that have a number of spacer ducts corresponding to the number of adjacent fuel rods, which are distributed over the periphery of the fuel rods. In this manner a lateral displacement of fuel rods is prevented. (J.S.R.)

19939 FLANGE-LIKE SPACER FOR REACTOR FUEL ELEMENTS WITH A NUMBER OF FUEL RODS. (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,085,976. July 28, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

The patent concerns a spacer for fuel rods in a bundle, in which the spacer support is not welded or soldered to the rods. The flange-like structure selected should have, in addition to low volume of structural material, the necessary strength properties. It should not affect the uniform removal of heat from the fuel rods and, in order to avoid fuel corrosion, the surface adjacent to the fuel rods should be as small as possible. The solution suggested is that the foil flange have a cross profile bent in the direction of the extension and have sections tangential to corresponding bulges or gaps in order to attach the fuel rods. In this way a rattle-free support with no lateral displacement was obtained, and the coolant cross section was only slightly compressed because of the edgewise placement of the flange. In addition the support has small tangential surfaces with the fuel cladding and does not hinder heat removal or enhance fuel corrosion. Because of the streamlining, the flanges are especially safe from twisting. The structure was attached either by spot welding to the protection tube or by suspending in the support hole of the protection tube. (J.S.R.)

19940 FLANGE-LIKE SPACER FOR REACTOR FUEL ELEMENTS WITH A NUMBER OF FUEL RODS. (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,085,977. July 28, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

The spacer flanges are introduced as sealed traverses connected with each other in the interstices of the fuel rods. In this manner a lateral deflection of the fuel rods was prevented. Because of the edge-wise placement of the flanges, the coolant cross section was decreased only slightly. There were only small tangential surfaces with the fuel cladding so that heat transfer was not hindered and fuel corrosion was not favored. The flange structure was attached either by spot welding or by suspension. (J.S.R.)

19941 REACTOR FUEL ELEMENTS WITH SPACING SPIRALS, CONSISTING OF A NUMBER OF FUEL RODS. (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,085,975. July 28, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

Fuel elements for heterogeneous reactors consist generally of a number of fuel rods collected into one or more bundles and which must be reinforced. The invention proceeds from the problem of providing a spacer on the basis of known spacer spirals. Each fuel rod does not possess a spiral, but all rods possess a common spiral. The arrangement is characterized by the fact that seven fuel rods arranged in a regular six-sided lattice are collected by a common support or spacer spiral running the entire length and are brought to intermediate spacing in such a way that each diagonal triple rod series is surrounded by the spiral at least once. The loops can be turned from the middle of the rods to the direction of each diagonal. (J.S.R.)

19942 METHOD FOR INCREASING THE BURN-UP IN HETEROGENEOUS REACTORS. (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,081,577. May 12, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

The patent concerns a method for increasing fuel burn-up in heterogeneous reactors. The method allows increased burn-up through a negative temperature coefficient. The flow direction of the moderator or of the coolant is reversed in dependence on the reactivity of the reactor, for example at the end of the burn-up time. (J.S.R.)

19943 WATER SEAL FOR NUCLEAR REACTORS. (to Kernreaktor Bau- und Betriebsgesellschaft m.b.H). German Patent DAS 1,089,083. Sept. 15, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

In a reactor containment vessel, the same safety device must prevent both too-high and too-low pressures. According to the patent, these requirements were fulfilled by a simple safe method in which a water seal is combined with a back-pressure safety device such that the water seal volume during reduced pressure was siphoned off in a few seconds with a specially constructed siphon. With a second siphon of similar construction, the water seal volume is again filled automatically or by hand after a predetermined time or after the pressure returns to normal. (J.S.R.)

19944 QUASI-HOMOGENEOUS REACTOR. Kurt Diebner. German Patent DAS 1,083,942. June 23, 1960. Kernenergie, 5: 66(Jan. 1962). (In German)

For preparing quasi-homogeneous mixtures from very heavy materials (e.g., lead) and from very light materials (e.g., water) it has been proposed to use Raschig rings of the given heavy metal in a cavity filled with a suitable liquid. This idea was extended to the construction of reactors. The reactor fuel elements and solid moderator blocks, in the shape of open cylinders, are stacked in a container penetrated by a coolant. In this way there is a quasi-homogeneous mixture of fuel, moderator, and coolant. Corrosion-resistant metals are necessary. The Raschig rings should be embedded in the liquid used as coolant. Various types of Raschig rings could be mixed with each other. In this manner, one could provide a relatively large nuclear volume with a small flow resistance, at the same time many surfaces are created for heat removal from the fuel. (J.S.R.)

19945 SHUT-OFF DEVICE FOR LIQUID-COOLED REACTORS. (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,081,579. May 12, 1960. Kernenergie, 5: 66 (Jan. 1962). (In German)

In the described device a neutron-absorber, hydraulically accumulated in a low-pressure container, is sent by flow reversal into the fission zone. The invention concerns a perfection of this shut-down method with the aim of obtaining improved damping and avoiding large pressure variations in the coolant system in the core vicinity. The improvements consist in the insertion of a buffer device containing a throttling member between the reversal device and the low pressure container. The buffer container and the throttle cross section are so adjusted that a pressure is built up in the control valve that is only slightly lower than the pressure in the reactor vessel. (J.S.R.)

19946 APPLICATION OF MONTE CARLO METHOD TO REACTOR CALCULATIONS. Takashi Nakayama, Akira Tsuruo, and Shigehiro An (Japan Atomic Energy Research Inst., Tokyo and Tokyo Univ.). Nippon Genshiryoku Gakkaishi, 4: 251-62(Apr. 1962). (In Japanese)

The Monte Carlo method is applied to reactor calculations which use sampling techniques to approximate the solution

of functional equations or physical models. The outline of Monte Carlo and sampling techniques are described. Reviews about core and shielding calculation are given. (auth)

19947 THE REACTIVITY EFFECT OF A REGULAR ARRAY OF EMPTY CYLINDRICAL CHANNELS IN A CRITICAL SYSTEM. J. T. Marti and J. P. Schneeberger (Sulzer Bros. Ltd. and Therm-Atom Ltd., Winterthur, Switzerland). Nuclear Sci. and Eng., 13: 1-5(May 1962).

A critical system consisting of a regular infinite array of cylindrical channels of any cross section in a homogeneous multiplying medium is divided into equivalent cells of finite height. For such a cell two-group diffusion theory is applied with additional terms for the loss and gain of neutrons by the channels. The resulting integral-differential equations are solved with sufficient accuracy by the perturbation method, giving the reactivity loss due to the channels. With the method proposed the neutron leakage at the ends of the channels is included and deviations from the original unperturbed flux of the reactor without channels are taken into account. The results are compared with calculations based on the usual assumption of unperturbed flux, using the Behrens formula to compute the diffusion lengths. It is shown that reactivity calculations are also possible for arrays of finite extent, assuming separability of the flux in an axial and a radial part. (auth)

19948 REFLECTED-REACTOR KINETICS. Charles Erwin Cohn (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 13: 12-17(May 1962).

The zero-power kinetic behavior of reflected reactors was investigated using a simple model, in order to determine what modifications are necessary in the use of bare-reactor kinetics in interpreting experiments in reflected reactors, especially in regard to measurement of prompt neutron lifetime by kinetics methods. It is found that, for the usual reflected reactor, the kinetic behavior of experimental interest corresponds to that of a bare reactor with the same 1/v lifetime. The model is also satisfactory for an unusual case, i.e., the fast-thermal coupled critical done in ZPR-III, in which some deviation from bare-reactor kinetics is observed. (auth)

19949 VOID VOLUME RATIOS DURING STEADY STATE LOCAL BOILING IN CASE OF CONSTANT POWER DISTRIBUTION. C. Hubers (Swedish State Power Board, Stockholm). Nuclear Sci. and Eng., 13: 54-9(May 1962).

A tentative method for the calculation of the void volume fraction at zero quality in case of constant heat input along the channel is presented. By assuming a constant volumetric condensation density, proportional to the squared flow velocity, the void volume fraction at zero quality can be predicted. Comparing the calculated void volumes with actual measurements for water, the error in the void calculation is less than ±25%. (auth)

19950 REACTOR SIZE SUFFICIENT FOR STABILITY AGAINST SPATIAL XENON OSCILLATIONS. Gerald S. Lellouche (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 13: 60-1(May 1962). (BNL-5738)

The existence of a critical reactor size that is absolutely stable independently of flux levels against higher spatial mode xenon oscillations in the presence of zero or negative temperature feedback is indicated. The desired criterion is shown to follow from the exact solution of the usual one-group model. Stability conditions for various fuels are listed for the first axial and diametral harmonics of bare and zero leakage reactors. (N.W.R.)

19951 APPLICATION OF THE PILE OSCILLATOR TO LARGE-NEUTRON-DOSE MEASUREMENT. Toyojiro Fuketa (Japan Atomic Energy Research Inst., Tokyo). Nuclear Sci. and Eng., 13: 61-2(May 1962).

The pile oscillator measures large neutron doses with the aid of a probe which consists of a single isotope. The neutron dose is derived from the measurement of the decrement of the macroscopic absorption cross section of the probe. The decrement is caused by neutron radiation. The absorption cross section of the product nucleus is negligibly small as compared with that of the original nucleus. Isotopes used as probes are discussed and evaluated. (N.W.R.)

19952 SOLUTION METHODS FOR THE GENERAL LINEAR DIFFERENTIAL EQUATION WITH APPLICATION TO THE REACTOR EQUATION. Rudolf Schulten and Eberhard Kern (Brown Boveri Krupp Reaktorbau GmbH, Mannheim, Ger.). Nukleonik, 4: 46-53(Feb. 1962). (In German)

The general linear differential equation plays a leading role in many areas of physics, particularly in reactor theory and the quantum theory. First, for example, the reactor equation is separable, so that one obtains for the reactor flux a standard differential equation (boundary value problem). When the coefficient occurring in the equation (material buckling coefficient) is position dependent, the problem solution is no longer elementary. An electronic computer is then necessary or one of the usual solution methods, under which the series development has the greatest significance for the treatment of the general case, must be used. A solution method is described which also depends on a series development, but which is also of a different type than the previously known series developments. It has special significance for the obtention of approximation solutions which arise from interruption of the series development and for the obtention of general expression on the solution. The formalism was applied to an example of the reactor equation. (tr-auth)

19953 NUCLEAR REACTOR STABILITY. A. Hitchcock. "Nuclear Engineering" Monographs. London, Temple Press Limited and New York, Simmons-Boardman Publishing Corporation, 1960. 69p.

Because the neutron multiplication in a reactor is affected by those changes in temperature, pressure, and other physical variables which change as a consequence of changes in power level, it is possible that the reactor power may tend to diverge or to oscillate divergently. Thus, the circumstances in which this can happen are examined, criteria for stability are obtained, and the form and period of the instability, should it occur, are described. The problems of control to which these phenomena give rise are briefly discussed. The study is concerned with solid-moderated, liquid-moderated, and boiling systems. (N.W.R.)

19954 A METHOD OF PRODUCING COMPLETELY ENCASED BODIES ON AN EXTRUSION PRESS. (to Metallgesellschaft Aktiengesellschaft). British Patent 892,471. Mar. 28, 1962.

A method is given for producing an encased fuel element which can be cut from the extruded body without uncovering the core and can be drilled without exposing the core material. The method comprises forming an extrusion billet of core material enclosed by a casing material of a deformational resistance at elevated temperatures lower than that of the core material and a cover member of the same basic material as the casing material but of higher deformational resistance. A suitable material for the cover portion is powdered metal, e.g., a heat-resisting sintered Al powder containing some oxide for Al-clad elements and a Zr alloy powder containing some oxide for Zr alloy-clad

elements. The method is especially suited for producing fuel elements containing a mixture of uranium oxide and Al powder as its fuel. (D.L.C.)

19955 IMPROVEMENTS IN OR RELATING TO THERMOMETER DEVICES. Ernest Franklin (to United Kingdom Atomic Energy Authority). British Patent 895,705. May 9, 1962.

A thermometer device for measuring temperatures in reactors is designed which is based on the change with temperature in the voltage-time integral required to saturate a ferromagnetic core. The device comprises a coaxial transmission line with a shorted end and an unshorted end, a rectangular hysteresis loop ferromagnetic core located on the inner conductor of the line adjacent the shorted end, means for applying current pulses of alternate polarity to saturate the core in alternate directions of magnetization, and means for integrating the voltage pulses appearing at the unshorted end as a result of reflections from the shorted end. (D.L.C.)

19956 SUPPORT HOUSING FOR EXTERNALLY SUPPORTING NUCLEAR FUEL ELEMENTS IN THE FORM OF PARALLEL RODS. (to Commissariat a l'Energie Atomique). British Patent 895,718. May 9, 1962.

A support housing for a reactor fuel rod assembly is designed in which each rod supports only its weight and is cooled efficiently. The housing comprises a cylindrical body with a plurality of compartments, each provided with abutments at its ends. The housing may be used several times, and a procedure is given for replacing the fuel rods. (D.L.C.)

19957 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Graham Coates (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 895,739. May 9, 1962.

An improved construction of an assembly of parallel fuel plates supported by side plates is described. The plates are formed with a pair of tabs on each of two opposite sides, the tabs being short compared to the plate length and arranged to fit into recesses in the support plates. The tabs and recesses are staggered so that the formation of ribs, which are apt to be brittle, in the support plates is reduced. (D.L.C.)

19958 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Henry Shull Arms and Gordon McConochie Insch (to English Electric Co. Ltd.). British Patent 895,774. May 9, 1962.

A control system is described for a graphite-moderated gas-cooled reactor. The control system comprises neutron-absorbing rods, a relay for inserting the rods into the reactor in response to reactor fault conditions, and means for releasing a neutron-absorbing fluid into the coolant if the rods are not inserted within a time interval after the occurrence of fault conditions. The fluid may be nitrogen. (D.L.C.)

19959 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Benjamin Neil Furber and John Anthony Wynne Huggill (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 895,776. May 9, 1962.

A reactor fuel arrangement for gas-cooled solid-moderated reactors is described for reducing the over-all pressure drop. The arrangement comprises an array of spaced parallel slabs of fissile material stacked vertically in a fuel passage with spaced interruptions to cause the coolant to flow alternately between the slabs. By-pass passages around the interruptions are also provided for allowing a proportion of the coolant to bypass the interruptions. The fuel slabs may be arranged in a zig-zag path with the fuel passage linear or vice versa, or the slabs and the passage both may be linear with baffles serving as the interruptions. (D.L.C.)

19960 IMPROVEMENTS IN AND RELATING TO NUCLEAR FUEL ELEMENTS. Milton Janes, Walter Pasold Eatherly, and Sheldon Ayers Taylor (to Union Carbide Corp.). British Patent 895,839. May 9, 1962.

A process is given for producing a fuel element of a graphite matrix containing up to 70 wt % of dispersed fissile actinide monocarbide. The process comprises baking a molded mixture of graphite, a carbonizable binder, and an actinide element or compound at a temperature less than 2050°C in an inert atmosphere containing a trace of nitrogen as a catalyst, the amount of carbon being in excess of the stoichiometric amount required for the formation of the monocarbide. It is possible to carry out graphitization first in an inert atmosphere or vacuum and then to cool the stock to a temperature less than 2050°C for producing the monocarbide in an inert atmosphere containing a trace of nitrogen. Five examples of the process are given in which fuel elements containing 3 to 30 wt % uranium were fabricated. (D.L.C.)

19961 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Alan Howard Cottrell and Michael Warwick Thompson (to United Kingdom Atomic Energy Authority). British Patent 895,892. May 9, 1962.

A method is given for increasing the bulk moderator to avoid self-sustained release of Wigner energy in gas-cooled graphite-moderated reactors. The method comprises lining the fuel channels with sleeves spaced from the walls to provide annular insulating spaces of such dimensions that heat transfer thereacross is by conduction, convection, and radiation at approximately equal rates. Two sleeve embodiments are described. (D.L.C.)

19962 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Manfred Siebker (to L. & C. Steinmüller G.m.b.H.). British Patent 895,955. May 9, 1962.

A reactor is described in which problems associated with the moderator are reduced by dispersing a granular solid moderator in the coolant. In order to avoid the wearing down by friction of the fuel elements, the moderator substance is made softer than that of the fuel element surfaces. The advantages of a moderator dispersed in the coolant are that, in boiling water reactors, a strong natural circulation is set up, and in gas-cooled reactors, the heat transfer properties of the coolant are improved. The moderator concentration in the coolant can be varied for higher or lower heat rates in the core. A sodium-cooled reactor is described which uses BeO particles suspended in the sodium as the moderator and effects heat transfer with sodium vapor. (D.L.C.)

19963 MEANS FOR OBTAINING ACCURATE MOVEMENT CONTROL OF A MEMBER. William Louis Green (to Electro-Hydraulics Ltd.). British Patent 896,148. May 9, 1962.

A hydraulic system is designed for obtaining accurate movement control of a member in either of two opposed directions, particularly a reactor control rod. The system comprises a unidirectional rotary pump hydraulically coupled to one side of a jack for supply or withdrawal of liquid from that side, the moving part of the jack being coupled to the control rod. An emergency operational device is provided for rapid movement to effect scramming. (D.L.C.)

19964 NUCLEAR REACTOR FUEL ELEMENT. (to U. S. Atomic Energy Commission). British Patent 896,343. May 16, 1962.

A compartmental fuel element is designed for use in pressurized water reactors. The advantages of such a fuel element are that the void provided between the cladding tube and the fuel pellets for thermal expansion is divided between the compartments and hence the collapse of the cladding tube is prevented, gross movement of the fuel pellet column is prevented, and in case of cladding tube rupture, only one compartment is exposed to the reactor coolant. An apparatus for stretching the cladding tube is described. (D.L.C.)

19965 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENT ARRANGEMENTS FOR NUCLEAR REACTORS. Eric William Vickers Acton (to General Electric Co. Ltd.). British Patent 896,571. May 16, 1962.

A reactor fuel element arrangement is designed for improved heat transfer. The arrangement comprises tubular fuel elements mounted together in a fuel channel to form a continuous tube through which, and over the outside of which, coolant can flow. Either the inner or the outer surface, or both, may have cooling fins. An annular supporting member of graphite is provided to join adjacent fuel elements. An embodiment of the fuel element arrangement is described for a gas-cooled, graphite moderated reactor. (D.L.C.)

19966 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Leonard George Ralfe and Francis Thomas William Paget (to United Kingdom Atomic Energy Authority). British Patent 896,889. May 23, 1962.

A method and an apparatus are given for testing for the presence of damaged fuel cartridges in gas-cooled reactors. The method comprises the steps of sampling coolant gas, delaying the gas samples so that the solid daughter products are principally derived from long-lived fission products, precipitating the solid daughter products on a surface, and counting only the betas and gammas of energies >1 Mev. Thus, high backgrounds due to induced coolant activity and short-lived fission products are eliminated. (D.L.C.)

19967 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Donald Williams (to United Kingdom Atomic Energy Authority). British Patent 897,145. May 23, 1962.

A reactor fuel element for CO_2-cooled reactors is designed with means for giving early warning of a leak. The means comprises a capsule containing radioactive gas, the capsule material being such that it melts and releases the radioactive gas when the fuel temperature rises above a safe level due to oxidation by coolant coming in through a leak. The radioactive gas escapes together with some fission products through the leak and actuates a coolant monitoring apparatus. The capsule may be of magnesium alloy and may be filled with Kr^{85}. (D.L.C.)

19968 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Herbert Chilvers Knights (to United Kingdom Atomic Energy Authority). British Patent 897,189. May 23, 1962.

A reactor fuel element is designed which has a thermocouple connection, can occupy any position in a fuel channel, and can be charged into a reactor without accurate positioning. The element has means for endwise self-alignment with adjacent elements in a channel, a plurality of electric contact rings at one end, a plurality of contact members at the other end for contacting the contact rings of an adjacent element, a thermocouple hot junction, electric connections between the hot junction and either a contact ring or member, and electric through-connections between other contact rings and members. A fuel element assembly embodying the invention is discussed. (D.L.C.)

19969 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Norman Bradley (to United Kingdom Atomic Energy Authority.) British Patent 897,232. May 23, 1962.

A reactor fuel element of the cluster type is designed to prevent overheating in the region of the spacing members where coolant flow is restricted. The element comprises 19 sheathed fuel members located in openings defined by grid-like spacing members. The portions of the fuel members adjacent the spacing members have their fuel replaced by a heat-insulating non-fissile material, e.g., magnesium oxide discs. (D.L.C.)

19970 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Aktiebolaget Atomenergi). British Patent 897,373. May 23, 1962.

A reactor using heavy water as coolant and moderator is designed which has improved self-regulating properties. Two embodiments of the reactor are described, one of the boiling type and the other of the pressurized water type. The fuel is in the form of assemblies less than $\frac{1}{10}$ of the reactor core length and having low resistance to water flow, and the amount of structural material in the reactor is low. In the boiling reactor, fuel assemblies are suspended on wires, and good contact is established between the cooling water and the moderating water. In the pressurized water reactor, the fuel comprises boxes filled with fuel bodies and forming vertical columns in the core, and baffles are provided for obtaining a thorough mixing of the water in the core. Steam accumulators are also provided to effect a rapid shutdown in event of steam formation. Fuel assembly designs for use in these two reactors are given. (D.L.C.)

19971 IMPROVEMENTS IN NUCLEAR REACTORS. (to Beteiligungs-und Patentverwaltungsgesellschaft mit Beschränkter Haftung and Brown, Boverie & Cie. Aktiengesellschaft). British Patent 897,388. May 23, 1962.

A reactor radiation shield is designed for containing the fission products due to a fuel element failure in a gas-cooled reactor. The shield comprises an inner iron shell enclosing the core, circulation loop, and heat exchanger; a shielding jacket of concrete enclosing the inner shell; and an outer iron shell enclosing the concrete jacket. The jacket and the shells form two interspaces through which scavenging gas is passed. A fuel-exchanging mechanism for replacing the fuel elements may be enclosed within the shield. (D.L.C.)

19972 FUEL LOADING DEVICE FOR A NUCLEAR REACTOR. Donald Mason Sutherland and Philip Rawson Tipper (to AEI John Thompson Nuclear Energy Co. Ltd.). U. S. Patent 3,035,994. May 22, 1962.

A loading and unloading device for reactors having a solid moderator with vertical fuel passages is designed so that it does not foul the control rods. With this device, the charging passages are positioned at the centers of cruciform areas, each area having a control rod at each internal and external corner but no control rods within the area. (D.L.C.)

19973 ELECTRONIC REACTOR SAFETY CONTROL DEVICE. Bernard G. Seeley and Charles C. Weeks (to North American Aviation, Inc.). U. S. Patent 3,035,995. May 22, 1962.

A fail-safe control system is designed which may be set to shut down a reactor rapidly at a predetermined neutron flux level. The system comprises a neutron-sensing means connected to an electronic circuit which in turn is connected to a safety control means, e.g., a BF_3 release system. For effecting the fail-safe feature in case of loss of line voltage supply or failure of the cathode heater element in the thyra-

tron, capacitors are incorporated within the electronic circuit. In actuation of the control means, an electrical current from the thyratron detonates the electrical squib of the BF_3 system, allowing the BF_3 gas to enter the reactor zone. (D.L.C.)

19974 JACKETED BODY. Edward C. Creutz (to U. S. Atomic Energy Commission). U. S. Patent 3,037,924. June 5, 1962.

A fuel element is designed for nuclear reactors. The fuel element comprises a core of fissionable material, a jacket of nonfissionable material (aluminum) around the sides of the core, an end cap of nonfissionable material contacting one end of the jacket, and heat-insulating material (MgO, ZnO, or Bi_2O_3) between the end cap and the core. (AEC)

19975 FUEL ELEMENT. Lloyd Robert Zumwalt (to U. S. Atomic Energy Commission). U. S. Patent 3,039,944. June 19, 1962.

A nuclear fuel element having reduced permeability to the transmission of fission products is described. A method for the fabrication of the improved fuel element is also given. Specifically, the fuel element comprises a centrally disposed fuel compact that is surrounded and enclosed by a barrier zone. In addition, the barrier zone is integrally connected to the fuel compact. The barrier zone is specially fabricated to include an inner region of zirconium carbide which is integrally connected to said compact; an intermediate region of zirconium metal is connected, in turn, to said inner zirconium-carbide region; and an outer region of zirconium carbide is connected to the intermediate zirconium-metal region. An exterior layer comprising graphite is integrally connected to the exterior of the barrier zone. The barrier zone of the fuel element substantially retards the passage of fission products from the interior fuel compact to the exterior of the fuel element. (AEC)

19976 NUCLEAR REACTOR WITH POWDERED FUEL. Darwin Krucoff (to U. S. Atomic Energy Commission). U. S. Patent 3,039,048. June 19, 1962.

A thermal nuclear reactor incorporating reaction chambers and coolant ducts disposed between the reaction chambers in a mass of solid moderator is designed. A suspension of uranium dioxide or uranium carbide in a nonreactive gas is located in the reaction chambers, the size of particles being such that the fuel is maintained in suspension by thermal convection currents alone, and a non-reactive gas is passed through the coolant ducts at a pressure greater than that in the reaction chambers. (AEC)

19977 MOLTEN PLUTONIUM FUELED FAST BREEDER REACTOR. Robert M. Kiehn, L. D. Percival King, Rolf E. Peterson, and Earl O. Swickard, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,041,263. June 26, 1962.

A description is given of a nuclear fast reactor fueled with molten plutonium containing about 20 kg of plutonium in a tantalum container, cooled by circulating liquid sodium at about 600 to 650°C, having a large negative temperature coefficient of reactivity, and control rods and movable reflector for criticality control. (AEC)

Power Reactors

19978 (ACNP-6108) PATHFINDER FLOODING COEFFICIENT. R. J. Holl and R. H. Vollmer (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Apr. 15, 1962. For Northern States Power Co., Minneapolis, and Central Utilities Atomic Power Associates. Contract AT(11-1)-58, 24p.

A discussion of the nature and importance of the flooding coefficient of reactivity of an integral nuclear superheat reactor is given. Results of experimental and theoretical determinations of the flooding coefficient, for a centrally located superheater with various superheater and boiler core loadings, are presented. A simple calculational technique, which is useful in survey work and parametric studies on a variety of lattices, is developed for the flooding coefficient. (auth)

19979 (APAE-92) STARTUP TESTING OF THE PM-2A NUCLEAR POWER PLANT. W. J. McCool, comp. (Alco Products, Inc., Schenectady, N. Y.). Mar. 31, 1962. Contract AT(30-1)-2639. 341p.

A detailed description of the PM-2A reactor, primary system, and instrumentation is presented. A general description of the secondary system and plant arrangement at Camp Century, Greenland is included. The results of the startup physics, shielding, thermal and hydraulics and radiochemistry test are presented. The analysis performed on the shielding and thermal and hydraulic tests is included. The shielding problem at startup and the shielding modification made to the plant are described along with the radiation measurements made in these areas. (auth)

19980 (APAE-114) PRELIMINARY TECHNICAL REPORT [ON] SM-1 CORE III WITH TYPE 3 ELEMENTS. J. N. Inglima, R. H. Beam, S. L. Davidson, and E. C. Edgar (Alco Products, Inc., Schenectady, N. Y.). Mar. 30, 1962. Contract AT(30-1)-2639. 62p.

The design of the SM Type 3 element, its use in SM-1 Core III, and planned use in the Type 3 Core for PM-2A is discussed. The Type 3 element characteristics are compared with Type 1 (SM-1 Core I) element nuclear, metallurgical, thermal and hydraulic characteristics and fabrication. The effect of using the Type 3 element in SM-1 Core III and its planned use in a Type 3 Core for PM-2A is discussed with regard to operation, shielding, reactor safety and all conceivable special problems. (auth)

19981 (DC-55-7-13) THE DESIGN POINT PERFORMANCE OF SHAPED WIRE AND RIBBON TYPE FUEL ELEMENTS BASED ON RECENT EXPERIMENTAL DATA. R. N. Noyes (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 30, 1955. Contract AT(11-1)-171. 16p.

The design point performance of shaped wire and ribbon type fuel elements of such geometry as to be used in solid moderated systems is discussed. Using the ratio of total pressure at core exit to total pressure at core inlet as an index of performance, this ratio was computed to be 0.692 for ribbon type fuel elements, 0.666 for shaped wire elements having un-fueled spacers, and 0.771 for shaped wire fuel elements having fueled spacers. The results indicated that for a longitudinal flat power distribution curve, the present core size is too small to handle the airflow from two 400 lb/sec engines at the design point flight condition of Mach 0.9 at 35000-ft altitude. It was concluded that if shaped wire fuel elements having fueled spacers are used in a core having a drooping power characteristic in the exit stages, the resulting total pressure ratio will be up to the design point value of 0.796. (auth)

19982 (DC-56-12-45) FUEL ELEMENT DEVELOPMENT FOR PROJECT 102. Summary Report. A. J. Butterfield (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 9, 1956. Contract AT (11-1)-171. 47p.

Tests conducted in the burner rig to produce fuel elements for the P-102 reactor are described. The P-102 reactor requires a 100-hr life at 1850°F with 6 psi dynamic head in the last element. In addition the ratio of support hardware to cladding should not exceed 36%. The elements described are all 2.7 in. in diameter with 12 rings spaced 0.080 in. apart. The most promising element had comb ribs to support the front and used no rear support hardware. This element had a friction factor comparable to the A-2, had a hardware-to-cladding ratio of 0.345, and could withstand P-102 operating conditions. (auth)

19983 (DC-57-4-76) INSULATION DESIGNS FOR GAS-COOLED REACTORS. Task 7470. Thomas D. McLay (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 4, 1957. Contract AT(11-1)-171. 28p.

Insulation designs which were successfully used in the P-101 HTRE #1 power plant or in test vehicles to prove designs for future power plants are outlined. (auth)

19984 (DC-60-4-118) ANALYSIS OF XENON REACTIVITY PREDICTION ON THE HTRE-1. S. K. Breslauer (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 11, 1960. Contract AT(11-1)-171. 38p.

To determine the effectiveness of ANP methods in predicting xenon poisoning, and to determine which analytic method is best employed, a comparative study was made of the xenon 135 poisoning in the HTRE-1 core using all the major diffusion theory models normally utilized in reactor analysis at ANP. Detailed procedures and data necessary for each calculation are included in the report. Results indicate excellent agreement among the three primary methods of calculation, two-group matched savings procedure, multigroup matched buckling procedure, and a perturbation calculation. However, the analytic values are 50 to 70% of the experimental xenon reactivity. This discrepancy is believed due in part to the limitations of the physical model of the thermal neutron flux incorporated in the present treatments. Discrepancies in the xenon absorption cross section may contribute to the inconsistent results. Physical measurements of the reactivity may also be somewhat in error. Calibration of the control rods varies with temperature, age, etc. On some runs there was a question as to whether all the rods were latched up. Doppler broadening of Xe^{135} thermal resonance and inaccuracies due to incorrect nuclear constants were investigated. Neither effect was large enough to explain the experiment-theory difference. (auth)

19985 (DCL-57-4-72) ANP TURBOPROP STUDIES BIBLIOGRAPHY. Anne D. Cope, comp. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 8, 1957. Contract AT(11-1)-171. 27p.

Documents, drawings, photographs, slides, and charts issued by ANPD and reports and drawings by AGT-FPLD, Lockheed, and Douglas Aircraft Company on ANP turboprop studies from April 8, 1955 to March 31, 1957 are listed. (auth)

19986 (HPR-22) RADIOLYTIC GAS PRODUCTION IN THE HBWR DURING FIRST CHARGE POWER OPERATION. Mons M. Lyng (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). Apr. 1962. 17p.

Observations and data concerning the first charge operation of the Halden Reactor are presented. Data show a gas production rate of 1.5 moles per Mw at power levels up to 5 Mw and coolant temperature of 150°C. Except for D_2 concentration peaks immediately following sudden power changes, the gas production was a linear function of the power level. (J.R.D.)

19987 (HW-73314) HANFORD STUDIES EXECUTED FOR THE USAEC-AECL COOPERATIVE PROGRAM ON DEVELOPMENT OF HEAVY WATER MODERATED POWER REACTORS. Monthly Progress Report, March 1962. S. Goldsmith, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 9, 1962. Contract [AT(45-1)-1350]. 5p.

Test sections of electrically heated 19-rod bundles were developed for heat transfer and fluid flow studies. The ultrasonic responses from notches in Zircaloy tubing were measured using a flat rectangular lithium sulfate transducer operated at 10 Mc. The ultrasonic response to pit-shaped defects was also determined. Test angle, instrument tuning, length of ultrasonic path, loading, transducer response, Lamb wave propagation theory, identification of mode and propagation frequency for pulsed systems, and verification of theoretical Lamb wave curves for Zircaloy using narrow frequency bands are discussed. (M.C.G.)

19988 (KAPL-M-JRT-2) REACTIVITY COEFFICIENTS IN PMA-47. A ZIRCONIUM–URANIUM, UNPOISONED SLAB CORE. PART II. ANALYSIS. J. R. Tomonto (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 8, 1962. Contract W-31-109-Eng-52. 46p.

The purpose of this report is to compare calculated criticality, reactivity coefficients, and flux distributions with related quantities measured in PMA-47. PMA-47 is the second of a series of cores constructed in the Plastic Mockup Assembly (PMA) to provide criticality data and reactivity coefficients in cores with simple geometry. A comparison of results is made to PMA-40 which was the first in this series. The two cores differ in that PMA-47 contains a higher fuel density and utilizes Zr as its principle structural material. The calculations were performed using the DIG-WOXX and MUFT-KATE cross section routines with the KARE diffusion theory code. (auth)

19989 (MND-M-1823) PM-1 NUCLEAR POWER PLANT PROGRAM 12TH QUARTERLY PROGRESS REPORT, DECEMBER 1, 1961 TO FEBRUARY 28, 1962. (Martin Co. Nuclear Div., Baltimore). Apr. 10, 1962. Contract AT(30-1)-2345. 46p.

Construction was completed on the PM-1 reactor. Plant installation and testing are described. Criticality was achieved at 6:43 PM, February 25, 1962. (M.C.G.)

19990 (NAA-SR-6879) STABILIZING SRE FUEL ELEMENTS. H. F. Donohue and H. A. Vislay (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1962. Contract AT(11-1)-GEN-8. 33p.

The method used to prevent thermal bowing of SRE fuel rods is described. Thermal bowing had resulted in an instability which was subsequently eliminated. Rigidity was achieved by installing a helical wire wrap around the fuel clusters. This reduced the power coefficient, measured at power levels to 5 Mw, from +9/Mw to −2.5¢/Mw. (auth)

19991 (NDA-2169-2) INVESTIGATION OF WET STEAM AS A REACTOR COOLANT (CAN-2). Technical Progress Report, June 1 to August 31, 1961. (United Nuclear Corp. Development Div., White Plains, N. Y.). Sept. 30, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2828. 36p. (NYO-9842; EURAEC-174)

Theoretical heat transfer effort was initiated with careful definitions of the quantities associated with two-phase flow and a review of the one-dimensional flow approximation used to predict pressure drop and vapor volume fraction. An initial mathematical application of a droplet diffusion model for predicting behavior of water–steam

mixtures under fog flow conditions was undertaken. A test apparatus intended to permit an investigation of the behavior of a stream of water droplets in saturated or superheated steam under atmospheric pressure was designed. Fabrication and assembly are in progress. (auth)

19992 (NYO-9792) SURVEY OF COMPONENT REQUIREMENTS AND AVAILABILITY FOR GAS-COOLED NUCLEAR REACTOR POWER PLANTS. BEARINGS AND SEALS. S. B. Malanoski and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). June 1961. Contract AT(30-1)-2512. 82p. (I-A2392-8).

Results of a survey made of effective bearings and seals used in primary loop components of gas-cooled nuclear power reactors are presented. Data were collected and are used in a critical review of the present state-of-the-art of the various bearing and seal systems currently being contemplated. Complete systems for four reactors and bearings for two additional reactors which are in a preliminary design state are covered. A discussion of key design features is included. (auth)

19993 (NYO-9793) SURVEY OF COMPONENT REQUIREMENTS AND AVAILABILITY FOR GAS-COOLED NUCLEAR REACTOR POWER PLANTS. STRUCTURAL MATERIALS. T. C. Yen (Franklin Inst. Labs. for Research and Development, Philadelphia). June 1961. Contract AT(30-1)-2512. 102p. (I-A2392-13)

Physical, thermal, nuclear, and mechanical properties of stainless steels, nickel-base alloys, and refractory metals are described. Corrosion resistance and fabrication are discussed. References to further details to aid in designing structural materials for gas-cooled reactors are given. (M.C.G.)

19994 (ORNL-TM-201) CONCEPTUAL DESIGN OF THE PEBBLE BED REACTOR EXPERIMENT. (Oak Ridge National Lab., Tenn.). May 17, 1962. Contract W-7405-Eng-26. 325p.

The Pebble-Bed Reactor Experiment (PBRE) was designed to advance the pebble-bed concept by providing a test of characteristic features and make contributions to the general development of all-ceramic gas-cooled reactors. The following objectives were established for the reactor experiment: to investigate key features of the pebble-bed concept, including on-stream fuel handling, movement of fuel through bed, and performance of core; to obtain operation and maintenance experience with a system contaminated with fission-product activity; and to investigate the behavior of graphite fuel elements. A fourth objective, study of the behavior of core materials at conditions occurring with exit gas temperatures in the range 2000 to 2500°F, was tentatively included. The preliminary design of a 5-Mw(t) reactor for achieving these objectives was prepared. The core of the PBRE is a 2½-ft-diam, 4-ft-tall cylinder containing approximately 12,000 spherical graphite fuel elements 1½ in. in diameter. Fuel spheres are added to and removed from the core by gravity flow, and these operations are performed while the reactor is at power by using pairs of valves for passage of elements into and out of the high-pressure system. Exposed fuel can be recycled to the top of the core. Helium coolant at 500 psia enters the bottom of the core at 550°F and emerges from the top at 1250°F. Concentric ducting connects the reactor to a single heat exchanger, which is located sufficiently high above the core that natural circulation will suffice to remove afterheat in the event the blower ceases to function. The coolant flow path is such that the entire pressure envelope is swept with helium at the temperature at which it emerges from the heat exchanger. Provision for semi-remote maintenance of contaminated components is emphasized in the layout, and most of the equipment in the primary and auxiliary systems is accessible from above by the removal of modular shielding units. The design permits replacement of the entire core graphite structure. The reactor can be adapted for testing core materials at high temperature by attemperation of the hot helium emerging from the core with cool gas in a plenum in the upper graphite structure. Location of the PBRE at the site of the HRE-2 facility is proposed to take advantage of available buildings and services, but the reactor and auxiliary equipment will be contained in a completely new vessel located adjacent to the existing building. The design and direct construction cost of the reactor plant is estimated to be $7,958,000; allowance for contingencies, overhead, and escalation brings the total to $12,260,000. High-temperature operation can be achieved when desired for an additional expenditure of less than $500,000. (auth)

19995 (PRDC-TR-53) MONTHLY TECHNICAL REPORT [ON POWER REACTOR DEVELOPMENT], NOVEMBER 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 17p.

A summary of progress is presented concerning core design, dummy subassembly cleaning, graphite testing, fuel and reactor materials development, nuclear engineering, shielding and health physics, instrumentation, liquid metal and steam systems, and test operations. (J.R.D.)

19996 (SRO-67) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT [FOR] APRIL 1962. (Savannah River Operations Office, AEC). 18p.

Research and development activities on heavy-water reactors are reported. Topics covered include: an on-power refueling machine for CANDU, boiler test for CANDU, development of sintered aluminum products (SAP), nondestructive tests of fuel elements, pressure tube development, zirconium technology, heat transfer at low heat flux, beryllium irradiation, physics, metallurgy, engineering, and critical assemblies for heavy-water reactor studies. Operation of the Heavy Water Components Test Reactor is discussed. Development progress on the Carolinas-Virginia Tube Reactor is reported. (M.C.G.)

19997 (TID-8538) SMALL POWER REACTOR PROJECTS OF THE UNITED STATES ATOMIC ENERGY COMMISSION. Information Gathered as a Result of the United States Offer Inviting the Agency's Participation. (Division of Reactor Development, AEC and International Atomic Energy Agency, Vienna). Sept. 28, 1961. 82p.

Presented at IAEA General Conference, fifth regular session, as report GC(V)/INF/41.

Information on small power reactor projects of the USAEC is summarized. General information concerning the projects as a whole is given. Specific projects discussed include: the Elk River Power Reactor, the Piqua Nuclear Power Facility, the BONUS Power Reactor, the Pathfinder Power Reactor, the small-size pressurized water power reactor, and the experimental low-power process heat reactor. (M.C.G.)

19998 (TID-15625) PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION. CORE 1, SEED 3. Section 2. Test Evaluation, DLCS-3070202. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 12, 1962. Second issue, Apr. 6, 1962. Contract [AT(11-1)-292]. 13p.

Tests were carried out to insure the reliable operation of the four self-actuated reactor coolant loop relief valves and the four self-actuated purification system relief valves. The valves operated properly, and the final set pressures were all within the prescribed limits (2530 ±

50 psig) except that of the 1BD hairpin loop. The set pressure of this valve was accepted since it exceeded the lower limit by only 3 psig. The valve temperatures which were measured before the manual flush of each relief valve indicated that there was no excessive leakage. (M.C.G.)

19999 (TID-15626) PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION. CORE 1, SEED 3. Section 1. Test Evaluation, DLCS-3070103. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 25, 1962. Second issue, Apr. 6, 1962. Contract [AT(11-1)-292]. 16p.

Tests were conducted to insure reliable operation of the self-actuated reactor relief valves and the self-actuated pressurizer steam relief valves. The valves operated properly, and the final set pressures were all within the specified limits. Neither valve chatter nor excessive pipe movement was evident during any of the valve operations. Data indicated that repair work performed on 4 relief valves was satisfactory. (M.C.G.)

20000 (TID-15627) REACTOR PLANT CONTAINER INTEGRITY TEST. Section 3. Test Evaluation DLCS-3570302. (Duquesne Light Co., Shippingport, Penna.). First issue, Jan. 4, 1962. Second issue, Mar. 26, 1962. Contract [AT(11-1)-292]. 21p.

Tests were conducted to inspect the interconnections and all pipe penetrations of the reactor plant container for signs of damage or rupture. A positive bolt tightness for the container hatches, reactor dome, and electrical stop joints was established by a bolt torquing sequence of tightening diametrically opposite bolts simultaneously. The conditions of all interconnections and pipe penetrations were satisfactory. (M.C.G.)

20001 (TID-15628) PRELIMINARY DESIGN FOR PARTICULATE REMOVAL VIA DISTILLATION—EXPERIMENTAL ORGANIC COOLED REACTOR. (Fluor Corp., Ltd., Los Angeles). June 19, 1961. Contract AT(10-1)-1040. 22p. (FLUOR-4052)

Methods for removing gaseous, high-molecular-weight, and inorganic particulate impurities from organic coolant in the Experimental Organic Cooled Reactor are described. In the proposed process a sidestream of coolant from the degasifier is concentrated in a vacuum flash evaporator system consisting basically of a flash tank with an external forced circulation electric heater. Flashed overhead evaporator vapors are heat exchanged with the liquid feed stream, then condensed, sub-cooled, and returned to the degasifier at the degasifier operating temperature. Noncondensable vapors are passed through a vent condenser to the organic freeze traps. The evaporator bottom material is recirculated through the electric heater to provide the heat required for vaporization. A sidestream of the bottom material is fed to the distillation column for separation of the recoverable coolant, high boilers, and particulates. (M.C.G.)

20002 (TID-15631) HYDROGEN DISTRIBUTION AND LEAK RATE FROM THE REACTOR COOLANT SYSTEM. CORE I, SEED 2. Test Evaluation, DLCS-3280102, RNI-31A. (Duquesne Light Co., Shippingport, Penna.). Apr. 6, 1962. Contract [AT(11-1)-292]. 15p.

Tests were carried out to determine the rate of hydrogen loss from the reactor coolant during steady-state operations with water seals in the pressurized steam space relief values. The feasibility of adding hydrogen at the inlet of the purification system ion exchangers as added protection against introducing undissolved hydrogen into the main coolant pumps was investigated. The time required for the hydrogen concentration to decrease to a value of $\frac{1}{2}$ the original concentration ranged from 118 to 172 hr. Hydrogen loss increased with increasing pressurizer spray flow. Hydrogen additions at the inlet of the ion exchanger had no effect on the ability of the exchanges to control coolant radioactivity. (M.C.G.)

20003 (WCAP-4124) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., CVTR PROJECT MONTHLY PROGRESS REPORT, APRIL 1962. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 19p.

Progress is reported on pressure tube assembly development and analysis, irradiation experiments and analysis, component development, plant system development, instrumentation, and critical experiments. (J.R.D.)

20004 (XDCL-59-12-719) D102A2 (A) POWER PLANT TEST PROGRAMS AND PROCEDURES FOR IET NO. 18. J. W. Highberg, R. F. Brenton, K. J. Skow, R. E. Wood, R. C. Rothermel, N. Bonicelli, and C. B. Cannon (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Dec. 16, 1959. Contract [AT(11-1)-171]. 82p.

The test programs and procedures for the completion of Phase I testing and the continuing tests termed Phase II are presented. The tests include: chemical engine performance, initial criticality and excess reactivity, partial power test, power map, transfer and determination of endurance point, endurance, and radiation around the assembly after shutdown. (M.C.G.)

20005 COST FUNCTION STUDIES FOR POWER REACTORS. Atomics, 15: No. 2, 25-7(Apr.-June 1962).

A mathematical method of determining power costs applicable to either nuclear or conventional plants is described. The cost function gives the cost in mills per kwh of generated electricity as a function of the various cost parameters. The cost function contains minor simplifications whose effect on mills per kwh is insignificant; it is not intended to serve as an accounting technique. The basis of the analysis is contained in the equation: revenue = capital charges + profit + operating expenses. (N.W.R.)

20006 THE TURBULENT GAS FLOW IN REACTORS OF THE TYPE OF THE PEBBLE-BED REACTORS. E. Kern (Brown Boveri/Krupp Reaktorbau GmbH, [Mannheim], Ger.). Atomkernenergie, 7: 121-30(Apr. 1962). (In German)

In the case of gas-cooled reactors, in which the cooling gas is led through channels within the core the flow distribution of the gas plays an important part to attain an optimal cooling effect and an even distribution of temperature. Regarding pebble-bed reactors there is no or only a very limited possibility to favorably influence the gas flow. In the central zone of the core the temperature of the gas rises due to the irregular generation of heat by the reactor and due to the existence of a radial flow component. The equations for a turbulent gas flow within a pebble-bed reactor can, based on general considerations, be obtained out of the known relations achieved by experiments for the pressure drop and the heat conductivity in pebble-beds. A non-linear system of partial differential equations was obtained representing a boundary value problem. This system describes the gas flow in pebble-beds in general, with a given distribution of heat sources, that occurs in many physical-chemical experiments, particularly in the field of process engineering. The speed of the gas flow appears in the equations with a fractional power exponent. The heat conductivity of the gas is increased by a factor of 100 to 1000 by the influence of the pebble-bed. An effective heat conductivity of the gas can be defined, being within the range of the heat conductivity of metal. Considering the

convective part of the heat transfer, the effective heat conductivity can, however, be neglected. The equations applied to turbulent gas flow in pebble-bed reactors are compared with the assumption given by L. S. Dzung for the case of a laminary gas flow through a pebble-bed. Subject boundary value problem can in general only be solved by means of an electronic computer. The special case of a turbulent gas flow without a radial component can be solved. The results are applied to the gas flow in a pebble-bed reactor. (auth)

20007 ECONOMY OF MAGNOX-ATOMIC POWER PLANTS IN GERMANY. D. C. Eastwood (Babcock and Wilcox and Taylor Woodrow Atomic Power Construction Co. Ltd., Whetstone, Leicester, Eng.). Atomwirtschaft, 7: 137-43(Mar. 1962). (In German)

The criteria that may establish nuclear power as commercially economical are discussed from technical and commercial viewpoints. The importance of the technical background of any nuclear power development is discussed. The economic characteristics of the nuclear power plants are described. The role of the station in the existing electricity generating and supply into which it would be integrated is outlined. Two stations typical of those that could be constructed in Western Germany in the next 5 years are postulated for illustration of the arguments involved: a hard-coal fired plant and a nuclear station based on UK stations currently under construction. (M.C.G.)

20008 FIRST FULL-SCALE NUCLEAR PLANT TAKES SHAPE. C. L. Moon. Can. Nuclear Technol., No. 4, 15-19(1962).

The progress and improved design features of the Douglas Point Nuclear Power Station, located on the eastern shore of Lake Huron, 130 miles northwest of Toronto, are described. The station will be powered by the heavy-water moderated and cooled, natural uranium fueled CANDU reactor. The station will have an electrical output of 200 Mw and an efficiency of 29%. Schematic diagrams are presented of the plant and mechanical equipment, reactor system, flow system, and the reactor. Descriptions are given of the coolant channels, calandria and dump tank, primary coolant system, moderator and helium system, end shields, fuel and fueling, turbine-generator, control system, and the special features. (N.W.R.)

20009 I. THE 150-Mwe ATOMIC POWER STATION WITH AN EVAPORATING REACTOR, DESIGNED BY AEG. E. Moldoványi. Energia és Atomtech., 15: 139-43(Mar. 1962). (In Hungarian)

The evaporating reactor planned by the AEG is based on a simple design: the heat generated by the reactor is used directly in the turbine, eliminating the need for heat exchangers. It is in principle similar to the reactors of the U. S. Dresden and the West German Kahl power stations, consisting of fuel elements immersed in light water, bringing it to boiling. The nominal primary steam generation will be 699 tons/hr under 68.5 atm. at 282°C at the turbine inlet while the secondary steam production will reach 217.3 tons/hr under 33.4 atm. at 217.3°C with a total reactor power of 507.8 Mw, a turbine power of 160 Mw, and net efficiency of 29.5%. Uranium oxide, enriched to 2.1%, will be used as fuel material for the first loading, while in subsequent operations material enriched to 1.84% will be used. The fuel elements will be designed in the shape of Zircaloy-clad rods, carefully leak-tested before use. A burnup level of 11,000 Mwd/t is planned. The light water will also act as the moderator. The steam generated between the fuel element exerts a negative effect on the reactivity, thus contributing to the self-stabilization of the system. No special shielding is provided for the turbine, fed by slightly radioactive steam, but the reactor vessel, the steam generator, and the secondary heat exchanger are heavily shielded with concrete. Eventual leakages will be decontaminated before sending them to the river; the fission gases will be filtered and then released through the stack. (TTT)

20010 THE DOUNREAY FAST REACTOR. J. L. Phillips. Énergie nucléaire, 4: 10-15(Jan.-Feb. 1962). (In French)

After a brief description of the reactor and the installations associated with it, the problems encountered since start-up are discussed. The problems are those expected during the operation of a system so new and complex. The solution of these problems permitted experience to be acquired in the utilization of liquid metals in long and complicated circuits and in the operation of mechanisms used in a liquid metal medium. (auth)

20011 HIGH TEMPERATURE REACTORS FOR MARINE PROPULSION. J. E. Richards (British Shipbuilding Research Assn., [London]). J. Joint Panel Nuclear Marine Propulsion, 6: 1-26(Apr. 1962).

Small marine reactors need enriched fuel and a possible supply may be the plutonium produced as a by-product of the civil power program. The possible use of this fuel in high temperature gas cooled reactors was investigated. The main interest was in designs requiring little extension of present technology so that a prototype ship would be possible at an early date. Although there is a distinct possibility that fuel costs for a 20000 shp plutonium burning reactor will reduce in time to about half oil fuel costs, the annual charges on the additional capital cost of a nuclear powered ship may outweigh this gain. The study was based on the premise that inherent safety is necessary for the reduction of capital costs to an acceptable level and this has led to the concept of a solid moderator acting as a heat sink under fault conditions. The reactor designs which were evolved are discussed and the general conclusion is reached that there appears to be no reason why the capital cost should not eventually be reduced to the required level. (auth)

20012 THE ATOM IN THE FUTURE. W. R. Wootton (Babcock and Wilcox Ltd., [London]). J. Joint Panel Nuclear Marine Propulsion, 6: 27-35(Apr. 1962).

The present position in the development of nuclear power plants is examined, and an attempt is made to assess the trend of development in the near and distant future, and to consider the technical problems that will arise. (auth)

20013 APPLICATION OF STRUCTURAL MATERIALS IN WATER-COOLED POWER REACTORS (SURVEY REPORT). W. Schimmel (VEB Entwicklung und Projektierung Kerntechnischer Anlagen, Berlin-Pankow). Kernenergie, 5: 3-13(Jan. 1962). (In German)

The requirements which structural materials must satisfy for utilization in power reactors are reviewed. The properties of materials used for reactor pressure vessels are discussed. Load-bearing materials, instrument components, shaft materials, and spring materials are also reviewed. 10 references. (J.S.R.)

20014 HIGH PRESSURE REACTOR. (to Deutsche Babcock & Wilcox-Dampfkesselwerke A. G.). German Patent DAS 1,095,959. Dec. 29, 1960. Kernenergie, 5: 65(Jan. 1962). (In German)

The invention concerns a gas-cooled high-pressure reactor with radial coolant channels along the axis of the reactor. The coolant channels also admit the fuel elements. Neutron economy is thereby improved since a completely

equal charge of all fuel elements, a similar neutron flux for all coolant channels, and a good adjustability through the fuel elements are obtained. High thermal efficiency and good fuel burn-up are also effected. In a spherical or cylindrical moderator with a given arrangement of fuel channels, the moderator properties vary as a function of distance from the midpoint or central axis, so neutron migration length is shorter in the interior than in the exterior layer. Different moderator materials, moderator densities, or concentrations of moderator mixtures could be present in the individual layers. (J.S.R.)

20015 A 360MW ADVANCED SODIUM GRAPHITE REACTOR. Nuclear Power, 7: No. 74, 71(June 1962).

A preliminary power plant design using uranium carbide fuel elements in a 360-Mw advanced sodium graphite reactor was developed. It is based on modest extrapolations of Sodium Reactor Experiment and Hallam technology; major differences are in the areas of fuel specified, type of steam generator, and method of separating sodium and graphite in the reactor. The reactor makes possible the attainment of high pressure and temperature steam required for economic power generation. The characteristics of the reactor are tabulated. (N,W.R.)

20016 ON-LINE COMPUTERS FOR POWER REACTORS. Harold L. Davis, Eric Beckjord, Raymond A. Edwards, Warren M. Gaines, Thomas J. Glass, Colin G. Lennox, and Albert Pearson. Nucleonics, 20: No. 6, 51-74 (June 1962).

On-line digital computer systems are described that can monitor and evaluate operating data and eventually control nuclear power plants. The process-control computers that are already operating conventional steam power plants are discussed. Nuclear power plants which now use computers for some automatic operations such as monitoring reactor temperatures, detecting burst fuel slugs, recording and processing experimental data, controlling closed-loop functions, and advising performance control are described. Reactors for which computer systems are discussed include Hanford, EDF-1, Shippingport, Big Rock Point, and Douglas Point. (N.W.R.)

20017 DIGITAL COMPUTERS IN NUCLEAR POWER APPLICATIONS. J. Prades and Y. Panis (Compagnie Européene d'Automatisme Electronique, Paris). p.119-26 of "Transactions of the Joint Nuclear Instrumentation Symposium." Pittsburgh, Instrument Society of America, 1961.

There are a number of interesting applications of digital control computers in the nuclear power field which demand highly reliable, high speed, and automatic operation. These include the monitoring of radioactivity levels, conventional monitoring and data recording, operation calculations on reactors, economic calculations and plant optimization. In the case of gas-cooled reactors with a thousand or more cooling channels one problem is to detect and localize dangerous increases in radioactivity due to gas leakage from background radiation which is subject to normal statistical variations of random types and variation in the mean level. This application of digital computers for monitoring radioactivity is discussed and an existing installation is described. (auth)

20018 A NUCLEAR REACTOR, AND A METHOD FOR ITS OPERATION. (to Deutsche Gold-und Silber-Scheideanstalt Vormals Roessler). British Patent 896,109. May 9, 1962.

A reactor is described which combines the advantages of homogeneous and heterogeneous reactors. In this reactor, fuel balls are guided through the reactor core in spiral tubes, thus effecting fuel change-over for uniform burning in a simple manner. The spiral tubes may be filled with a liquid, e.g., water, molten metal alloy, or organic liquid, for facilitating the movement of the fuel balls and the heat transfer to the tube walls. One advantage of the reactor is that casing for the fuel balls may be omitted, since the spiral tubes serve to contain the fission products and to separate the coolant from the fuel. Possible combinations of fuel, casing, coolant, spiral tube material, and heat exchange medium are given. (D.L.C.)

20019 IMPROVEMENTS IN OR RELATING TO THE SUPPORT OF A LONG RIGID BODY IN A SHIP. Norman Thomas Barrett (to United Kingdom Atomic Energy Authority). British Patent 896,339. May 16, 1962.

A method is given for mounting a nuclear reactor in a ship without impairing the flexibility of the ship. The biological shield of the reactor is surrounded by two bearing rings. One bearing ring is welded to bulkheads stiffened in the longitudinal direction of the ship by longitudinal webs, while the other bearing ring is welded to bulkheads stiffened in a transverse direction but not in the longitudinal direction, so that the bulkheads can flex as a diaphragm. (D.L.C.)

20020 IMPROVEMENTS IN AND RELATING TO THERMAL POWER PLANTS. Myles Hutchinson and Waldemar Hryniszak (to C. A. Parsons & Co. Ltd.). British Patent 897,009. May 23, 1962.

A thermal power plant is designed which can be operated at low temperatures and low pressures, e.g., with a reactor as the heat source. A fluorocarbon as the working fluid is pressurized by a pump to the supercritical state, is heated by the gaseous reactor coolant in a heat exchanger, and is expanded in a turbine. The use of a fluorocarbon cycle reduces the amount of heat transfer surface required and eliminates the need for a dual pressure cycle. (D.L.C.)

Production Reactors

20021 (HW-72545) PLUTONIUM RECYCLE CRITICAL FACILITY CONTROL OF EXCESS REACTIVITY. N. G. Wittenbrock and W. K. Winegardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 31, 1962. Contract AT(45-1)-1350. 11p.

Procedures to be used in controlling available excess reactivity in the Plutonium Recycle Critical Facility are described. A brief description of tests planned for the facility and the estimated maximum required excess reactivity necessary for testing are given. Control of reactivity by fuel or moderator addition and control rod withdrawal is discussed. (M.C.G.)

Research Reactors

20022 (APEX-459) HAZARDS SUMMARY REPORT FOR SUSIE REACTOR. C. W. Luke, D. L. Gilliland (General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho) and R. E. Baker (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Feb. 3, 1959. Contract AT(11-1)-171. Includes Appendix A: REACTIVITY CHANGES CAUSED BY COMPRESSION OF AN MTR-TYPE LATTICE. L. C. Noderer. (CF-53-1-253). 63p.

Includes Addendum: APEX-518. Sept. 11, 1959.

A description of the Susie reactor and an evaluation of the hazards of its operation at the Shield Test Pool Facility are presented. The site, facility, characteristics of the reactor, topography, climatology, geology, pool operation, experimental arrangement, and reactor operation are described. Hazards by operators, hazards due to unexpected failure of components, and uncontrollable hazards are discussed. (M.C.G.)

20023 (HW-73021) REVISED REPORT OF THE REACTOR HAZARDS FOR THE PHYSICAL CONSTANTS TESTING REACTOR. H. L. Henry, P. F. Nichols, and E. C. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 66p.

The Physical Constants Testing Reactor (PCTR) has been operated successfully for over six years. The reactor as it exists today is described, measured values for control element worths are presented, and the reactor hazards analyzed. The reactor is essentially a 7-foot cube of graphite with a large cavity in the center, about $3\frac{1}{2} \times 3\frac{1}{2} \times 3$ feet deep. It is made critical with uranium enriched to at least 92% in U^{235} and runs normally at a power of 1 to 10 watts. Sections of various lattices are inserted into the test cavity. The effects of the test lattice on the PCTR reactivity are measured and neutron distributions inside the test lattice are determined. There are two mechanical safety systems on the reactor; eight shutter-type control rods, which are driven to the closed position by springs in about 0.25 seconds, and two large cadmium disks that fall freely into the reactor in about 0.5 seconds. These 10 mechanical safety devices have individual driving and electromagnetic release mechanisms. The electromagnets are controlled by neutron flux monitoring through five electronic channels; two are fission chamber channels for subcritical and post-critical monitoring, while the remaining three are ion chamber channels for subcritical and level monitoring. If all the mechanical shutdown devices should fail, and if an excursion were to continue until limited by vaporization of the fuel, 2×10^{18} fissions would occur. An analysis of the effects shows that consequences outside the reactor building would be limited to nuisance contamination within the 300 Area. Maximum dosage to personnel in the plume and 100 meters from the building is estimated as less than 15 rem total body plus 15 rem beta from contaminants deposited on the skin. (auth)

20024 THE SAFETY IN THE INSTRUMENTATION OF THE ARGOS REACTOR. A. Tanarro, J. Goñi, and J. E. De Carlos (Junta de Energia Nuclear, Madrid). Anales real soc. españ. fis. y quím. (Madrid), Ser. A, 57: 289-302(Nov.-Dec. 1961). (In Spanish)

Several peculiarities were introduced in the instrumentation of a low-power experimental reactor of the Argonaut type. Improved characteristics were achieved by slight modifications in standard circuits of linear safety channels for low-power reactors. (auth)

20025 SLOW NEUTRON SPECTRUM IN THE HORIZONTAL BEAMHOLE OF THE VVR-M REACTOR. V. P. Vertebnyĭ, M. F. Vlasov, V. V. Kolotyĭ, A. N. Maĭstrenko, and M. V. Pasechnik. Atomnaya Energ., 12: 324-6(Apr. 1962). (In Russian)

A 3000-mm-diam. mechanical chopper with a 0.5-mm-wide slit, the rotational velocity of which could be adjusted from 100 to 10,000 rpm, was installed at the VVR-M reactor at the Physical Institute of the Academy of Sciences. It is planned to replace the currently installed 25-m-long piping with a 175-m-long and 1000-mm-diam. pipe. A set of $B^{10}F_3$ counters was used as neutron detectors. The time channel widths were 0.5, 1, 2, 4, 8, 16, 32, and 64 μsec with a dead time of 16 μsec. The devices were provided with ferrite cores having a rectangular hysteresis curve. The spectrum of slow neutrons from the horizontal beamhole of the reactor was determined with this apparatus. The measurements were carried out at 243 rpm at 128 μsec/m, corresponding to a resolution of 4.8 μsec/m. During the tests the core was kept at 295.4 and 309°K. The results indicate that within the applicability of the notion of temperature to the neutron gas, the neutron temperature within the beam is very close to the core temperature, probably because of the slowing down of the neutrons in beryllium. (TTT)

20026 RESEARCH REACTORS IN BRITISH INDUSTRY. A. J. Salmon (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). Atomwirtschaft, 7: 151-5(Mar. 1962). (In German)

The role of industry in the design and construction of research reactors in the United Kingdom is discussed. The various reactors designed and constructed by different companies are described. The industrial research reactor MERLIN is described and its operation discussed. (M.C.G.)

20027 DIP TUBE IN NUCLEAR POWER REACTORS. (to Deutsche Babcock & Wilcox-Dampfkesselwerke A. G.). German Patent DAS 1,095,409. Dec. 22, 1960. Kernenergie, 5: 65(Jan. 1962). (In German)

A dip tube to expose material samples or elements to the neutron flux of a reactor is described. The function of the device is to avoid the disadvantages that arise from the accumulation of material in the tube wall. For this purpose, the dip tube was constructed as a pressure vessel in which the dip direction, coolant flow, and blower were arranged in a single direction. The complete device was introduced into a power reactor operating at constant temperature and pressure. Therefore either a sleeve could be placed between the reactor interior wall and the dip tube or the tube could be sealed in the reactor with a joint and a gas tight stuffing box. The exterior wall of the dip tube is used only for the introduction of the coolant gas. (J.S.R.)

20028 A REACTOR FOR INDUSTRIAL RESEARCH. Dean B. Holzgraf. Research Reactor J., 2: No. 3, 1-6 (Apr. 1962).

The Research Center of Union Carbide Nuclear Company is described along with its 5-Mw swimming pool-type research reactor. The reactor core can be located in either of two sections of the demineralized light water-filled pool. One section is open for bulk irradiations. The other section contains six beam tubes, two pneumatic shuttle tubes, and a graphite-filled thermal column. Brief descriptions are given of radioactive waste liquid treatment, ventilation system, radiochemical laboratory, maintenance shop, experimental facilities, and radioactive materials laboratory. The research programs are briefly discussed. (N.W.R.)

20029 DEVELOPING RESEARCH REACTOR MAGNETS. J. F. Hagan, Jr. Research Reactor J., 2: No. 3, 14-17(Apr. 1962).

The development and characteristics of four types of research reactor magnets are discussed. The magnets are the Mark I (spherical face Armco magnetic ingot iron type), Mark II (flat face Armco magnetic ingot iron type), Mark III (flat face ferro-nickel type), and an out-of-water ferro-nickel type. Characteristics receiving special emphasis are magnetic holding current and breakaway time. Operating experience is also discussed. (N.W.R.)

20030 THE HIGH FLUX REACTOR OF REACTOR CENTRUM NEDERLAND. B. M. Nelissen. Electronica, 15: No. 348, 13-17; 21(1962).

The High Flux Reactor at Petten went critical November 9, 1961. The reactor was furnished by Allis-Chalmers. The following details are described: reactor formation, reactor tank, reactor core, control rods, shielding, beam tubes, irradiation facilities, cooling systems, and reactor building. The reactor fuel consists of 90% enriched uranium; the maximum power amounts to 20 Mw. A short description is given of the Argonaut-type 10 kw Low Flux Reactor at Petten. (NPO)

SPACE APPLICATIONS AND TECHNOLOGY

20031 (AD-263667) SOVIET NUCLEAR INSTRUMENTATION AND CONTROL FOR PROPULSION. Report No. 6. (Library of Congress. Air Information Div., Washington, D. C.). Aug. 15, 1961. 11p. (AID-Report-61-120)

Design and performance information is given concerning gamma spectrometers with organic scintillators, fast response Wilson cloud chamber valves, grid shielding in grid ionization chambers, and rectangular Wilson chambers. Information is also included on a 1-kw fast burst reactor. (J.R.D.)

20032 (ASD-TR-61-224) INVESTIGATION OF A MAXIMUM MACH NUMBER PLASMA ACCELERATION CHANNEL. A. C. Eckert and R. G. Weirick (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). May 26, 1961. Contract AF 33(616)-7151. 96p. (AD-263444)

An experimental and theoretical investigation of a magnetohydrodynamic plasma acceleration device was performed. The specific device of interest utilized the field configuration resulting from the theoretical analysis of the Maximum Mach Number concept as applied to a linear acceleration channel having a constant cross-sectional area. Methods of producing a plasma suitable for acceleration were investigated and a theoretical and experimental analysis of plasma conductivity in the presence of a magnetic field has been performed. The MHD acceleration of a low-temperature, low-pressure plasma was observed and a limited correlation with theory has been obtained. (auth)

20033 INTEGRATING ISOTOPIC POWER SYSTEMS. R. T. Carpenter (Air Force, Washington, D. C.) and Douglas G. Harvey. Astronautics, 7: No. 5, 30-1; 58; 60-1(May 1962).

Some characteristics that cause unique interface problems between the radioisotope-fueled thermoelectric power supply and the space vehicle pay-load are discussed. The interface problems discussed are electrical, thermal, and radiative integration. The electrical characteristics of Transit 4A generator are shown. A circuit diagram is shown for a (d-c)-(d-c) converter along with the power distribution of the converter. The radiation dose one-foot from the core of the generator is tabulated for various radioactive fuels. (N.W.R.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 19208.

20034 (AERE-R-3496) INVESTIGATIONS INTO THE USE OF ION EXCHANGE RESINS FOR THE DECONTAMINATION OF RADIOACTIVE EFFLUENT. PART I. LABORATORY TRIALS. (Permutit Co., Ltd., London and United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1960. 28p.

An ion exchange process was used to treat radioactive effluent at A.E.R.E. Harwell. A regeneration scheme is described which gave waste arisings for the system of 1.8 to 2.4% of the throughput for a range in the untreated effluent total cations from 9.82×10^{-3} to 7.82×10^{-3} equivalents per liter. A modified regeneration scheme is suggested by which it is calculated that the waste arisings for this system could be reduced to approximately 1.0 to 1.4% of the throughput. (auth)

20035 (GEAP-3542) AN INCINERATOR FOR URANIUM CONTAMINATED WASTES. R. J. Chandler and R. C. Thorburn (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 28, 1960. 12p. (R60APE-31)

Developmental tests, equipment, and operation of an incinerator for burning uranium contaminated wastes are described. (auth)

20036 (LA-2664) HEAT GENERATION IN THE DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTES. H. J. Longley, E. F. Gloyna, and C. W. Christenson (Los Alamos Scientific Lab., N. Mex.). Jan. 1962. Contract W-7405-eng-36. 84p.

A general and versatile computer code was needed to provide estimates of temperature in and near a containment cavity filled with a variety of high-level wastes. Three codes were developed, tested for accuracy, and compared. Two general purpose codes consider a variety of physical input values for the multiregion, variable-geometry, and variable-effective thermal conductivity cases. The third code was written to provide approximate temperature estimates, but it does not consider a change in effective thermal conductivity. An auxiliary code was written to provide an estimate of the waste that could be put into a cavity when, due to structural or chemical requirements, a maximum permissible temperature is specified. (auth)

20037 ON THE PROBLEM OF STORAGE OF RADIOACTIVE WASTES. Werner Kliefoth. Atomkernenergie, 7: 147-54(Apr. 1962). (In German)

An estimate on the quantities of radioactive fission products accumulating during the operation of a reactor is given. A presentation is made of the various methods for neutralizing by dilution or concentration and a discussion of their usability is given. The methods for the final storage of highly active waste products are discussed in detail. Recent investigations by Zimakov and Kulicenko on the fixation of fission products in a glass-type material indicate that this method has advantages as compared to the localization in concrete, clay, or molten salts. (auth)

20038 REACTIONS BETWEEN RADIOACTIVE POLLUTION AND SUSPENDED MATTER IN STREAMS. G. Stroehl. Deut. gewässerkundl. Mitt., Sonderheft, 36-9(1960).

Processes of adsorption and ion exchange between radioactive materials and suspended matter in streams are discussed. Results are given of investigations into the effect of various coagulants on the removal of different radioactive isotopes, the content of radioactivity in filtered and unfiltered Rhine water, and the difference between radioactivity of surface and bottom water in the Rhine. (Public Health Eng. abstr., 42: No. 3, March 1962).

20039 CATION EXCHANGERS ON A SUGAR-BEET PULP BASE. APPLICATION FOR DECONTAMINATING RADIOACTIVE WASTE WATER. W. T. J. P. Langenhorst, M. Tels, J. C. Vlugter, and H. I. Waterman. J. Biochem. Microbiol. Technol. Eng., 3: 7-20(1961).

Experiments were carried out on the use of sugar beet pulp, which is a weakly acidic cation-exchange material with a capacity of about 0.62 mg equivalent per g of dry matter. It was found that sugar beet pulp adsorbs the salts of alkaline earth metals selectively in the presence of both sodium and lathanum, and it successfully decontaminated a solution containing barium-140 and lanthanum-140 with an activity of about 10^{-2} μC per ml. Treatment of the pulp with formaldehyde and hydrochloric acid greatly reduced the amount of water bound to the pulp and increased the exchange capacity six-fold. Treatment with formaldehyde, hydrochloric acid, and dilute sulfuric acid also produced an exchange material with good mechanical and filtration properties and with a capacity of about 1.3 mg equivalent per g of dry matter. (Public Health Eng. abstr., 42: No. 3, March 1962)

20040 DISPOSAL OF RADIOACTIVE WASTES INTO MARINE AND FRESH WATERS. (International Atomic Energy Agency, Vienna). Bibliographical Series No. 5. Mar. 1962. 368p. (STI/PUB/21/5). $3.00(IAEA)

A bibliography, published in English, French, Russian, German, Italian, Japanese, and other languages, is presented covering literature on the subject of radioactive waste disposal into marine and fresh waters. The 1918 references are grouped under the following headings: general information, source and nature of wastes, treatment, engineered storage, disposal, monitoring and findings, legal aspects, and economics. Under each heading the material is listed alphabetically by authors. Cross references and an author index are included. (M.C.G.)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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æ	becomes	ae
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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

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263288*	16-19751	See RADC-TN-61-154
263390*	16-19842	See ML-833
263444*	16-20032	See ASD-TR-61-224
263459*	16-19653	See GCA-61-37-A
263521*	16-19058	OTS
263530*	16-19840	See GCA-TR-61-39-A
263667*	16-20031	OTS
263777*	16-19836	See AFCRL-549
263818*	16-19457	OTS
263872*	16-19295	See ASD-TR-7-888(1)
265360*	16-19458	OTS
265365*	16-19459	
265421*	16-19330	
265446*	16-19839	See AFOSR-1441
265447*	16-19724	See AFCRL-573
265707*	16-19757	OTS
265759*	16-19059	OTS
265762*	16-19837	See AFCRL-760
265857*	16-19460	OTS
265935*	16-19307	See NOR-61-236
266007*	16-19172	OTS
266011*	16-19432	OTS
266062*	16-19331	OTS
266072*	16-19173	OTS
266254*	16-18713	See AFSWC-TN-61-26
266569*	16-19473	See RADC-TN-61-196
266646*	16-19744	See AFOSR-1565
266808*	16-19154	See AFCRL-1038
267035*	16-19481	See WIS-OOR-31
267194*	16-19833	OTS
267238*	16-19845	See SRS(PPL)-103
267448*	16-19294	OTS
267668*	16-19467	See MRL-104
268286*	16-19461	OTS
268299*	16-19035	See AFSWC-TN-61-29(Pt.I)
268422*	16-19462	OTS
268506*	16-19463	See AFCRL-984
268799*	16-19834	OTS
AE–	**(Swedish)**	
67	16-19060	Dep.(mc)
AEC-tr–		
4148	16-18722	Dep.; $0.75(OTS)
4149	16-18723	Dep.; $0.50(OTS)
4152	16-18724	Dep.; $0.75(OTS)
4879	16-19377	Dep.; $3.00(OTS)
4956	16-18770	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5034	16-19217	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5056	16-18725	Dep.(mc); $2.60(fs), $1.04(mf) JCL
5059	16-19378	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5084	16-19681	Dep.(mc); $2.60(fs), $1.04(mf) JCL
5106	16-18857	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5108	16-19017	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5109	16-19049	Dep.(mc); $3.60(fs), $1.40(mf) JCL
5113	16-19379	Dep.(mc); $1.10(fs), $0.80(mf) JCL
AECL–	**(Canadian)**	
1478	16-19067	See CREL-1061
1503	16-19066	See CRDC-1083
AEEW-R–	**(British)**	
77	16-19905	Dep.; $0.84(BIS)
AERE-AM–	**(British)**	
89	16-18809	Dep.; $0.35(BIS)
AERE-M–	**(British)**	
1010	16-19174	Dep.; $0.42(BIS)
1011	16-19906	Dep.
AERE-R–	**(British)**	
3496	16-20034	Dep.(mc)
AFCRL–	**(Non-AEC)**	
549	16-19836	OTS
573	16-19724	OTS
595	16-19653	See GCA-61-37-A
760	16-19837	OTS
766	16-19840	See GCA-TR-61-39-A
984	16-19463	OTS
1038	16-19154	OTS
62-28	16-19843	See PIBMRI-959-61
62-222	16-19835	OTS
AFOSR–	**(Misc.)**	
300*	16-19838	
1441*	16-19839	OTS
1565*	16-19744	OTS
AFSWC-TN–	**(Non-AEC)**	
61-26	16-18713	OTS
61-29(Pt.I)	16-19035	
AGARDograph–	**(Non-AEC)**	
57	16-19141	"Microminiaturization. Proceedings of the Agard Conference, Oslo, July 24–26, 1961," Pergamon Press, 1962
AID-Report–	**(Non-AEC)**	
61-120	16-20031	See AD-263667
AMP–	**(Non-AEC)**	
54	16-19838	See AFOSR-300
AMRL–	**(Non-AEC)**	
532	16-18757	
ANL–		
6279	16-19148	Dep.; $0.75(OTS)
6327	16-19332	Dep.; $1.00(OTS)
6521	16-19234	Dep.; $1.75(OTS)
6527	16-19887	Dep.; $2.00(OTS)
6531	16-19061	Dep.; $0.50(OTS)
6533	16-19006	Dep.; $0.50(OTS)
6540	16-19175	Dep.; $1.00(OTS)
6557	16-19007	Dep.; $2.50(OTS)
APAE–	**(Misc.)**	
92	16-19979	Dep.(mc); $19.75(fs), $9.47(mf) OTS
114	16-19980	Dep.(mc); $6.60(fs), $2.06(mf) OTS
APED–	**(Non-AEC)**	
3892	16-19040	
APEX–		
459	16-20022	Dep.(mc); $6.60(fs), $2.09(mf) OTS
518	16-20022	Included in APEX-459
912	16-19062	Dep.(mc); $10.50(fs), $4.16(mf) OTS
ARCRL–	**(British)**	
6	16-19176	$0.28(BIS)
ARF–	**(Misc.)**	
1193-9	16-19745	Dep.(mc); $5.60(fs), $1.79(mf) OTS
1194-10	16-19214	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2198-13	16-19333	Dep.(mc); $4.60(fs), $1.46(mf) OTS
2227-5*	16-19334	
3184-14	16-19184	See TID-15305
ARL–	**(Non-AEC)**	
62-305	16-19464	$1.25(OTS)
ASD-TR–	**(Non-AEC)**	
7-888(1)	16-19295	
61-207	16-19335	OTS
61-224	16-20032	OTS
61-648	16-19433	OTS
61-684	16-19336	OTS
ATL-A–		
112	16-19296	Dep.(mc); $1.10(fs), $0.80(mf) OTS
114	16-19297	Dep.(mc); $1.10(fs), $0.80(mf) OTS
119	16-19298	Dep.(mc); $1.60(fs), $0.80(mf) OTS

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120	16-19299	Dep.(mc); $1.60(fs), $0.80(mf) OTS
122	16-19041	Dep.(mc); $1.10(fs), $0.80(mf) OTS
123	16-19042	Dep.(mc); $2.60(fs), $0.89(mf) OTS
BAW–	**(Misc.)**	
1237	16-19746	Dep.(mc); $2.60(fs), $0.83(mf) OTS
1247	16-19434	Dep.(mc); $14.00(fs), $6.26(mf) OTS
BM-RI–	**(Misc.)**	
5975*	16-19337	Free(Bureau of Mines)
5982*	16-19338	Free(Bureau of Mines)
5987*	16-19339	Free(Bureau of Mines)
BMI–	**(Misc.)**	
1569(Del.)	16-18714	Dep.; $2.00(OTS)
BNL–		
711	16-19063	Dep.; $1.00(OTS)
715	16-18758	Dep.; $0.50(OTS)
5594	16-19452	Phys. and Chem. Solids 23: 221-7(1962)
5666	16-18789	Radiation Botany 1: 229-32(1962)
5738	16-19950	Nuclear Sci. and Eng. 13: 60-1(1962)
5888	16-18785	Radiation Botany 1: 203-8(1962)
5977	16-19131	Rev. Sci. Instr. 33: 565-6(1962)
BTGR–	**(Non-AEC)**	
48-2	16-19153	See A/AC.82/G/L.709
CEA-tr–	**(French)**	
A-1035	16-19080	Dep.(mc); $1.10(fs), $0.80(mf) JCL
A-1040	16-19758	Dep.(mc); $2.60(fs), $0.98(mf) JCL
R-1424	16-19218	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
R-1453	16-19251	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
R-1475	16-19846	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
CENRD–		
163	16-19907	Dep.; $0.50(OTS)
CERN–	**(European Organization for Nuclear Research)**	
62-9	16-19747	Dep.(mc)
62-10	16-19064	Dep.(mc)
62-11	16-19065	Dep.(mc)
CF–	**(Oak Ridge National Lab.)**	
53-1-253	16-20022	See APEX-459
CLM-R–	**(British)**	
16	16-18849	Dep.; $0.63(HIS)
CRDC–	**(Canadian)**	
1083	16-19066	Dep.; $1.00(AECL)
CREL–	**(Canadian)**	
1061	16-19067	Dep.; $1.00(AECL)
CU–	**(Misc.)**	
6-62-AEC 1934-Phys.	16-19888	See TID-15484
D-BIB–		
2	16-19250	See TID-15414
3	16-18818	See TID-15415
5	16-18853	See TID-15416
8	16-19675	See TID-15418
13	16-19882	See TID-15419
32	16-19047	See TID-15190
DASA–	**(Misc.)**	
1245*	16-18731	
1246*	16-18732	
DC–	**(Misc.)**	
54-1-75	16-19043	Dep.(mc); $6.60(fs), $2.03(mf) OTS
55-6-12	16-19068	$1.60(fs), $0.80(mf) OTS
55-7-13	16-19981	$1.60(fs), $0.80(mf) OTS
55-8-129	16-19044	Dep.(mc); $2.60(fs), $0.83(mf) OTS
56-12-45	16-19982	$4.60(fs), $1.61(mf) OTS
57-4-76	16-19983	$2.60(fs), $1.04(mf) OTS
58-2-206	16-19340	Dep.(mc); $5.60(fs), $1.73(mf) OTS
59-2-83	16-19341	Dep.(mc); $2.60(fs), $0.83(mf) OTS
59-2-721	16-19069	$2.60(fs), $1.04(mf) OTS
59-3-207	16-19342	Dep.(mc); $2.60(fs), $0.83(mf) OTS
59-4-106	16-19343	Dep.(mc); $2.60(fs), $0.98(mf) OTS
59-5-86	16-19908	Dep.(mc); $2.60(fs), $1.07(mf) OTS
59-9-18	16-19242	Dep.(mc); $8.10(fs), $2.66(mf) OTS
59-12-117	16-19344	Dep.(mc); $3.60(fs), $1.31(mf) OTS
59-12-222	16-19070	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60-3-77	16-19008	Dep.(mc); $7.60(fs), $2.33(mf) OTS
60-4-118	16-19984	Dep.(mc); $3.60(fs), $1.34(mf) OTS
60-7-12	16-19235	Dep.(mc); $7.60(fs), $2.45(mf) OTS
60-7-119	16-19881	Dep.(mc); $5.60(fs), $1.73(mf) OTS
60-12-158	16-19345	Dep.(mc); $1.10(fs), $0.80(mf) OTS
61-3-34	16-19243	Dep.(mc); $6.60(fs), $2.06(mf) OTS
DCL–		
57-4-72	16-19985	Dep.(mc); $2.60(fs), $1.07(mf) OTS
DF–	**(Misc.)**	
57TG177*	16-19045	
DP–		
671	16-18984	Dep.; $0.75(OTS)
673	16-18810	Dep.; $0.50(OTS)
679	16-19300	Dep.; $0.50(OTS)
680	16-19009	Dep.; $0.50(OTS)
704	16-19071	Dep.; $0.50(OTS)
708	16-19010	Dep.; $0.50(OTS)
720	16-18985	Dep.; $0.50(OTS)
DUBNA REPORTS		**(Russian)**
See JINR (Russian)		
EG and G-B	**(Non-AEC)**	
2311	16-19432	See AD-266011
EM–	**(Misc.)**	
7516*	16-19834	See AD-268799
EURAEC–		
7	16-19301	Dep.(mc); $2.60(fs), $1.01(mf) OTS
8	16-19302	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9	16-19303	Dep.(mc); $1.10(fs), $0.80(mf) OTS
11	16-19304	Dep.(mc); $4.60(fs), $1.55(mf) OTS
20	16-19244	Dep.(mc); $1.60(fs), $0.80(mf) OTS
56	16-19305	Dep.(mc); $1.60(fs), $0.80(mf) OTS
60	16-19311	Dep.(mc); $1.60(fs), $0.80(mf) OTS
63	16-19297	See ATL-A-114
66	16-19346	Dep.(mc); $7.60(fs), $2.51(mf) OTS
69	16-19245	Dep.(mc); $1.10(fs), $0.80(mf) OTS
73	16-19358	See NCSC-2663-3
74	16-19357	See NCSC-2663-1
77	16-19347	Dep.(mc); $1.60(fs), $0.80(mf) OTS
89	16-19333	See ARF-2198-13
90	16-19296	See ATL-A-112
91	16-19298	See ATL-A-119
116	16-19246	Dep.(mc); $1.60(fs), $0.80(mf) OTS
127	16-19359	See NCSC-2663-4
128	16-19360	See NCSC-2663-5
139	16-19299	See ATL-A-120
157	16-19041	See ATL-A-122
167	16-19177	Dep.(mc); $1.10(fs), $0.80(mf) OTS
174	16-19991	See NDA-2169-2
189	16-19746	See BAW-1237
201	16-19380	Dep.(mc); $2.60(fs), $1.04(mf) OTS
217	16-19042	See ATL-A-123
235	16-19361	See NCSC-2663-6
239	16-19348	Dep.(mc); $5.60(fs), $1.82(mf) OTS
245	16-18850	Dep.(mc); $1.60(fs), $0.80(mf) OTS
246	16-19072	Dep.(mc); $1.60(fs), $0.80(mf) OTS
249	16-19349	Dep.(mc); $2.60(fs), $0.92(mf) OTS
252	16-19350	Dep.(mc); $2.60(fs), $0.89(mf) OTS
253	16-19306	Dep.(mc); $1.60(fs), $0.80(mf) OTS
268	16-19351	Dep.(mc); $3.60(fs), $1.34(mf) OTS
FLUOR–		
4052	16-20001	See TID-15628
FN-E–	**(Italian)**	
17	16-19306	See EURAEC-253
18	16-19350	See EURAEC-252
19	16-19351	See EURAEC-268
FTD-TT–	**(Non-AEC)**	
61-342	16-19824	OTS
62-147	16-19825	OTS
62-323	16-19847	OTS
62-376	16-19921	OTS
62-414	16-19440	OTS

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62-417	16-19848	OTS
FZK–	**(Non-AEC)**	
9-175	16-19074	See NARF-62-4T
GA–	**(Misc.)**	
563	16-19435	Dep.(mc); $3.60(fs), $1.22(mf) OTS
GAMD–	**(Misc.)**	
657	16-19436	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GC(V)/INF–		
41	16-19997	See TID-8538
GCA–	**(Non-AEC)**	
61-37-A	16-19653	OTS
GCA-TR–	**(Non-AEC)**	
61-39-A	16-19840	OTS
GCM-UK–	**(British)**	
24	16-18946	Dep.(mc)
GEAP–	**(Misc.)**	
3542*	16-20035	
HPR–	**(Norwegian)**	
22	16-19986	Dep.(mc)
HW–		
59653	16-19247	Dep.(mc); $1.10(fs), $0.80(mf) OTS
62689	16-18986	Dep.(mc); $1.60(fs), $0.80(mf) OTS
66206	16-19285	Dep.(mc); $1.60(fs), $0.80(mf) OTS
67697	16-19178	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68037	16-19286	Dep.(mc); $1.10(fs), $0.80(mf) OTS
71260	16-19909	Dep.; $1.75(OTS)
72545	16-20021	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73021	16-20023	Dep.; $1.50(OTS)
73072	16-19437	Dep.; $5.60(fs), $1.79(mf) OTS
73135	16-18987	Dep.(mc); $1.10(fs), $0.80(mf) OTS
73314	16-19987	Dep.(mc); $1.10(fs), $0.80(mf) OTS
73381	16-19236	Dep.; $2.00(OTS)
HW-SA–		
2539	16-19073	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2560	16-19352	Dep.(mc); $7.60(fs), $2.36(mf) OTS
2564	16-19046	Dep.(mc); $9.10(fs), $3.44(mf) OTS
2578	16-19910	Dep.(mc); $4.60(fs), $1.49(mf) OTS
2586	16-19911	Dep.(mc); $8.60(fs), $2.93(mf) OTS
HW-tr–		
36	16-19288	Dep.(mc); $4.60(fs), $1.46(mf) JCL
I-A–	**(Misc.)**	
2392-8	16-19992	See NYO-9792
2392-13	16-19993	See NYO-9793
IDO–		
11102	16-19438	Dep.(mc); $2.60(fs), $1.10(mf) OTS
16738	16-19912	Dep.; $0.75(OTS)
IS–		
352	16-18881	J. Chem. Phys. 36: 2062-71(1962)
440	16-19353	Dep.; $0.75(OTS)
JINR–	**(Russian)**	
P-858	16-19674	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-101	16-19465	
32-126	16-19841	
KAPL–		
2203	16-19287	Dep.; $2.50(OTS)
KAPL-M–		
FDF-1	16-19237	Dep.(mc); $3.60(fs), $1.34(mf) OTS
JOS-1	16-19011	Dep.(mc); $1.10(fs), $0.80(mf) OTS
JRT-2	16-19988	Dep.(mc); $4.60(fs), $1.58(mf) OTS
JVM-3	16-19012	Dep.(mc); $3.60(fs), $1.13(mf) OTS
SLJ-7	16-18811	Dep.(mc); $2.60(fs), $0.92(mf) OTS
LA–		
1697	16-19748	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2664	16-20036	Dep.; $2.00(OTS)
2667	16-19466	Dep.; $1.50(OTS)
LAMS–		
2640	16-19354	Dep.; $1.50(OTS)
2660	16-19179	Dep.; $2.75(OTS)
2702	16-19180	Dep.; $0.50(OTS)
MCW–		
1445	16-18812	Dep.; $0.50(OTS)
MITNE–		
9	16-19438	See IDO-11102
ML–	**(Misc.)**	
833*	16-19842	OTS
MND-M–	**(Misc.)**	
1823	16-19989	Dep.(mc); $4.60(fs), $1.58(mf) OTS
MPR-XIII–		
3-62	16-19048	See TID-15619
MRL–	**(Non-AEC)**	
104	16-19467	OTS
NAA-SR–		
6488	16-19913	Dep.; $0.50(OTS)
6879	16-19990	Dep.; $0.75(OTS)
6881	16-19355	Dep.; $0.50(OTS)
7132	16-19356	Dep.; $0.50(OTS)
NARF–	**(Non-AEC)**	
62-4T	16-19074	
NASA-TN–	**(Misc.)**	
D-1176*	16-19468	$0.50(OTS)
D-1198*	16-18851	$0.75(OTS)
NCSC–	**(Misc.)**	
2477-5	16-19215	Dep.; $2.25(OTS)
2663-1	16-19357	Dep.(mc); $3.60(fs), $1.37(mf) OTS
2663-3	16-19358	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2663-4	16-19359	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2663-5	16-19360	Dep.(mc); $2.60(fs), $1.01(mf) OTS
2663-6	16-19361	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NDA–	**(Misc.)**	
2169-2	16-19991	Dep.(mc); $3.60(fs), $1.28(mf) OTS
NOR–	**(Non-AEC)**	
61-236	16-19307	OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
11389	16-19155	Dep.(mc)
11613	16-19469	
11617	16-19470	
11625	16-19641	
11627	16-19362	
11628	16-19248	
11641	16-19181	
11650	16-19149	
11660	16-18759	
11662	16-19749	
11676	16-19013	
11678	16-18733	
11689	16-19363	
11690	16-19249	
11699	16-19364	
NRC–	**(Canadian)**	
6750	16-19661	Can. J. Phys. 40: 540-9(1962)
6794	16-19685	Can. J. Phys. 40: 573-85(1962)
NYO–		
9217	16-18947	Dep.; $3.50(OTS)
9792	16-19992	Dep.; $2.00(OTS)
9793	16-19993	Dep.; $2.25(OTS)
9842	16-19991	See NDA-2169-2
10195	16-18813	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORA–	**(Misc.)**	
03736-7-T*	16-19473	See RADC-TN-61-196
ORNL–		
310	16-19014	Dep.(mc); $8.10(fs), $2.87(mf) OTS
ORNL-TM–		
201	16-19994	Dep.(mc); $19.75(fs), $9.35(mf) OTS
221	16-19238	Dep.(mc); $1.10(fs), $0.80(mf) OTS
223	16-18988	Dep.(mc); $1.60(fs), $0.80(mf) OTS
224	16-19914	Dep.(mc); $1.60(fs), $0.80(mf) OTS
228	16-19915	Dep.(mc); $1.60(fs), $0.80(mf) OTS
231	16-18858	Dep.(mc); $1.60(fs), $0.80(mf) JCL
234	16-19239	Dep.(mc); $1.10(fs), $0.80(mf) OTS
ORO–		
484	16-18814	Dep.; $0.50(OTS)

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551	16-19365	Dep.(mc); $1.10(fs), $0.80(mf) OTS
PAN–	**(Polish)**	
261/VII	16-19750	Dep.
266/IV	16-18852	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
892,471	16-19954	
895,705	16-19955	
895,718	16-19956	
895,739	16-19957	
895,759	16-19143	
895,774	16-19958	
895,776	16-19959	
895,839	16-19960	
895,892	16-19961	
895,893	16-19023	
895,955	16-19962	
896,053	16-18998	
896,109	16-20018	
896,126	16-19232	
896,148	16-19963	
896,269	16-19233	
896,339	16-20019	
896,343	16-19964	
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126P	16-18715	Dep.; $0.50(OTS)
130P	16-18716	Dep.; $1.25(OTS)
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132F	16-18718	Dep.; $2.25(OTS)
PPAD–		
451 E	16-19531	Rev. Sci. Instr. 33: 574-5(1962)
457D	16-19182	Dep.(mc); $1.10(fs), $0.80(mf) OTS
PRDC-TR–		
53	16-19995	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PWAC–	**(Misc.)**	
165	16-19308	Dep.(mc); $5.60(fs), $1.82(mf) OTS
R–	**(Misc.)**	
1616*	16-19149	See NP-11650
60APE-31*	16-20035	See GEAP-3542
62SD13*	16-19844	
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RAD-TR–	**(Non-AEC)**	
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61-154	16-19751	OTS
61-196	16-19473	OTS
RDA–		
1	16-18719	Dep.; $0.50(OTS)
REIC–	**(Non-AEC)**	
23	16-19439	
RME–		
4514	16-19156	Dep.; $0.50(OTS)
4515	16-19157	Dep.; $0.50(OTS)
4564	16-19183	Dep.; $0.50(OTS)
RR–	**(Misc.)**	
56-50	16-19308	See PWAC-165
RSG-C–	**(Non-AEC)**	
1	16-19181	See NP-11641
SB–	**(Non-AEC)**	
61-55	16-19013	See NP-11676
SCR–		
467	16-19725	Dep.; $1.75(OTS)
SCTM–		
362-61(73)	16-19015	Dep.; $1.00(OTS)
SRO–		
67	16-19996	Dep.(mc); $1.60(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
SRS(PPL)–	**(Non-AEC)**	
103	16-19845	
STI-PUB–	**(International Atomic Energy Agency)**	
21/5	16-20040	$3.00(IAEA)
51(Vol.II)(p.41-52)	16-19824	See FTD-TT-61-342
SUI–	**(Misc.)**	
61-5	16-19752	Dep.(mc); $4.60(fs), $1.64(mf) OTS
TDR–	**(Non-AEC)**	
594(1214-01)TR-1	16-19833	See AD-267194
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782	16-19158	Dep.; $1.00(OTS)
796	16-19159	Dep.; $0.50(OTS)
808	16-19160	Dep.(mc); $4.60(fs), $1.52(mf) OTS
TID–		
4563(3rd Rev.)	16-19216	Free, Division of Technical Information Extension
8538	16-19997	Dep.; $2.00(OTS)
14386	16-19474	Dep.(mc); $7.60(fs), $2.60(mf) OTS
15190	16-19047	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15228	16-19366	Dep.(mc); $4.60(fs), $1.46(mf) OTS
15305	16-19184	Dep.; $1.50(OTS)
15414	16-19250	Dep.(mc); $2.60(fs), $1.07(mf) OTS
15415	16-18818	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15416	16-18853	Dep.(mc); $1.10(fs), $0.80(mf) OTS
15418	16-19675	$2.60(fs), $0.83(mf) OTS
15419	16-19882	Dep.(mc); $3.60(fs), $1.34(mf) OTS
15484	16-19888	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15619	16-19048	Dep.(mc); $2.60(fs), $1.07(mf) OTS
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15630	16-19240	Dep.(mc); $3.60(fs), $1.40(mf) OTS
15631	16-20002	$1.60(fs), $0.80(mf) OTS
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15642	16-19476	Dep.(mc); $19.75(fs), $3.07(mf) OTS
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6368-T	16-19557	p.47-53 of "Ionization Phenomena in Gases, Vol. I." Amsterdam, North-Holland Publishing Company, 1962
6772	16-19479	Dep.; $0.75(OTS)
6872-T	16-19373	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9527(Rev.)	16-19509	Nuovo cimento (10) 24: 1-8(1962)
9861(Rev.)	16-19106	Nuclear Instr. & Methods 15: 74-6(1962)
9883(Rev.)	16-19755	Dep.; $4.50(OTS)
9983	16-18948	Dep.; $2.50(OTS)
9986	16-19125	Rev. Sci. Instr. 33: 526-9(1962)
10027	16-19698	Nuovo cimento (10) 24: 184-5(1962)
10029	16-19480	Dep.; $1.50(OTS)
10032	16-18802	Dep.; $2.50(OTS)
10034	16-19662	J. Geophys. Research 67: 1699-1709(1962)
10045	16-18749	Dep.(mc); $3.60(fs), $1.22(mf) OTS
10062	16-18856	Dep.; $1.75(OTS)
10127	16-19678	Dep.; $1.75(OTS)
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WADD-TR–	**(Non-AEC)**	
60-418(Pt.III)	16-19310	OTS
61-72(Vol.III)	16-19376	OTS
61-91(Pt.II)	16-19150	OTS
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WAPD-TM–	**(Misc.)**	
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4124	16-20003	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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